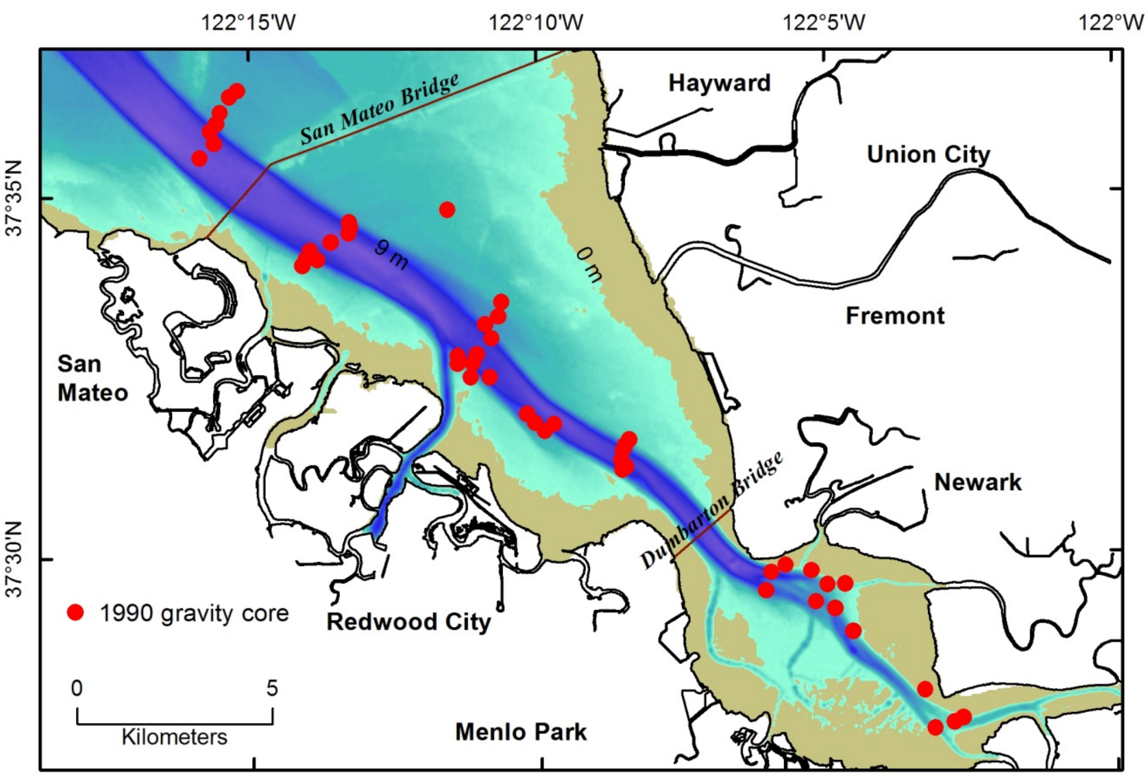
Late Holocene Sedimentary Environments of South San Francisco Bay, California, Illustrated in Gravity Cores



Open-File Report 2014-1198

U.S. Department of the Interior
U.S. Geological Survey

Cover: Location of gravity cores collected from south San Francisco Bay, California, in 1990 and described in this report. Maximum bay floor depth in this area as measured from mean lower low water is 25 m.

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By Donald L. Woodrow, Theresa A. Fregoso, Florence L. Wong, and Bruce E. Jaffe

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Conversion Factors

SI to Inch/Pound

Multiply	By	To obtain
	Length	
centimeter (cm)	0.3937	inch (in.)
millimeter (mm)	0.03937	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
kilometer (km)	0.5400	mile, nautical (nmi)
meter (m)	1.094	yard (yd)

Late Holocene Sedimentary Environments of South San Francisco Bay, California, Illustrated in Gravity Cores

By Donald L. Woodrow[1], Theresa A. Fregoso[2], Florence L. Wong[3], and Bruce E. Jaffe[3]

Abstract

Data are reported here from 51 gravity cores collected from the southern part of San Francisco Bay by the U.S. Geological Survey in 1990. The sedimentary record in the cores demonstrates a stable geographic distribution of facies and spans a few thousand years. Carbon-14 dating of the sediments suggests that sedimentation rates average about 1 mm/yr. The geometry of the bay floor and the character of the sediment deposited have remained about the same in the time spanned by the cores. However, the sedimentary record over periods of centuries or decades is likely to be much more variable. Sediments containing a few bivalve shells and bivalve or oyster coquinas are most often found west of the main channel and near the San Mateo Bridge. Elsewhere in the south bay, shells are rare except in the southernmost reaches where scattered gastropod shells are found.

Introduction

The south bay, as referred to here, is the area of the San Francisco Bay Estuary that extends from the San Mateo Bridge south to the mouth of Coyote Creek (fig. 1). A narrow, deepwater shipping channel extends the length of the bay. At the San Mateo Bridge, the bay is approximately 11 km wide but it narrows to approximately 3 km wide at the Dumbarton Bridge. A broad section south of the Dumbarton Bridge narrows toward the mouth of Coyote Creek. Wetlands cut by small meandering channels and several main creeks originally rimmed the entire bay but the wetland extent has been greatly reduced by salt evaporators, residential developments, and industrial sites. About one-fifth of the evaporators are being restored to wetlands, resulting in partial restoration of the tidal prism to historical levels.

Data are reported here on 51 gravity cores collected as part of a comprehensive San Francisco Bay coring program carried out in 1990 (Anima and others, 2005) by the U.S. Geological Survey (USGS; cruises J-1-90-SF and J-2-90-SF). These Anima and Clifton cores are referred to hereafter as "A/C cores." Figure 2 shows the location of the cores in the south bay. Descriptive and graphic logs of the cores provide a sedimentologic context for efforts by the State of California and the California Coastal Conservancy to return some of the salt ponds rimming the south bay to their prior status as wetlands. Of the 51 cores, 39 are reported as graphic logs based on core descriptions. X-radiographs provided the basis for graphic logs of 12 cores, which were otherwise unavailable. A shapefile of

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sample locations and metadata suitable for geographic information systems (GIS) are available from the website for this report.

Despite being sealed in plastic core liners and stored in a cooler maintained at 39 °F since their collection in 1990, the A/C cores have undergone some desiccation and considerable oxidation. Most of the cored sediment remained moist, but in a few instances, sediment dried enough to shorten and fracture the cores. Some sediment is brown, whereas surficial sediments in estuaries are typically gray or other dark colors (Friedman and others, 1992). Sediments range from Munsell colors N3/N4 to 2.5Y/5Y, which appears to be a result of oxidation of iron-bearing minerals in the sediment. In a few cores, an earthy, red material very much like hematite now coats fracture surfaces and the interior walls of burrows.

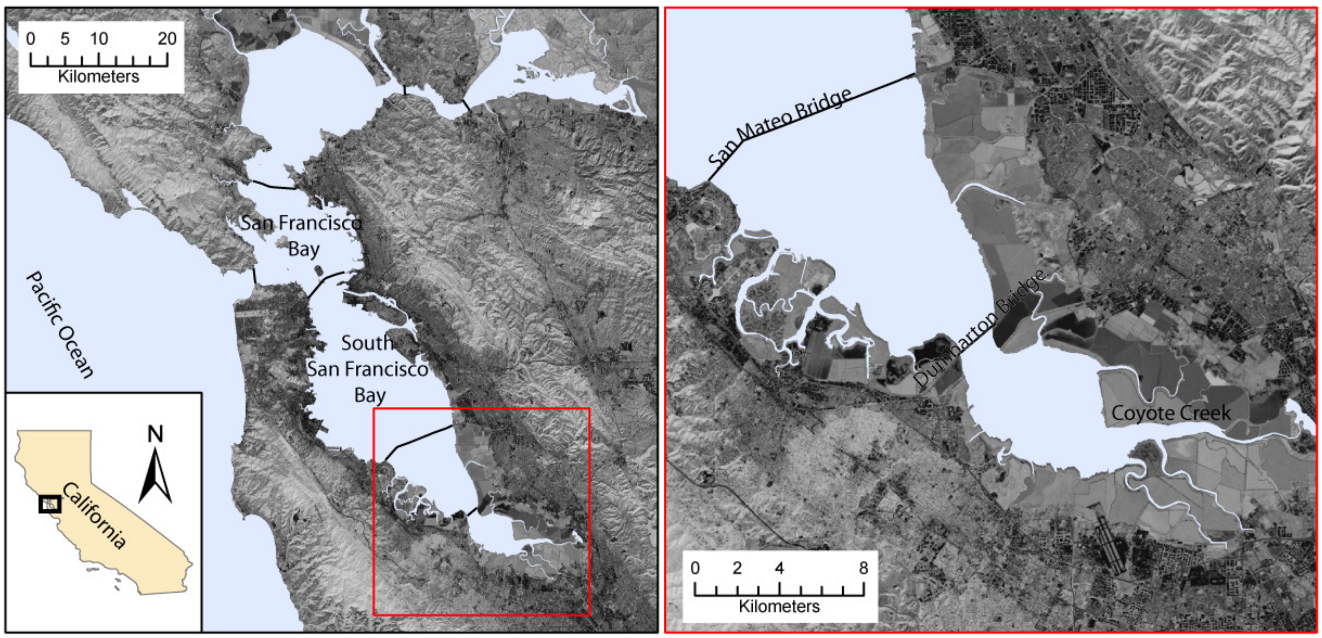

Figure 1. Maps showing location of study area in the San Franscisco Bay Estuary

When originally collected, most A/C cores were 2–3 m long and 8 cm in diameter. Cutting, capping, and sealing the cores was accomplished while shipboard. Core logging was accomplished in the USGS Core Lab in Menlo Park, California. The core-splitter cannot accommodate cores longer than 1.5 m, so it was necessary to cut longer cores into two core segments, an upper "A" segment and a lower "B" segment. This procedure yielded 80 core segments from the 51 cores.

Cores were split and examined under incandescent light at the macroscopic level. Split cores reveal sediment type and color, grain size, lithologic sequence, desiccation features, carbonate and sulfide reactions to hydrochloric acid, and some details about stratification. X-radiographs disclose sedimentary structures, stratal sequence, orientation and structure of shells, bioturbation, and core length before splitting and storage.

Data were compiled in a handwritten log for each of the split cores and X-radiographs and entered into a database maintained by the USGS. The hand-written logs are available at *http://walrus.wr.usgs.gov/infobank/j/j190sf/html/j-1-90-sf.meta.html* and *http://walrus.wr.usgs.gov/infobank/j/j290sf/html/j-2-90-sf.meta.html*. Included in this report are graphic logs of the A/C cores derived from the database (appendix 3).

Nineteen radiocarbon dates were obtained on bivalve shells taken from the cores (table 1). Seven radiocarbon dates obtained from cores taken near the San Mateo Bridge by Story and others (1966) were incorporated into the dataset.

Sediments sampled by the cores were deposited under a range of estuarine conditions. Environments at the south bay locations varied over time as water depth changed due to sea-level rise, subsidence, and sedimentary infilling (Atwater, 1979; Atwater and others, 1977 Barnett, 1984; Patrick and Delaune, 1990; Rogers and Figuers, 1992).

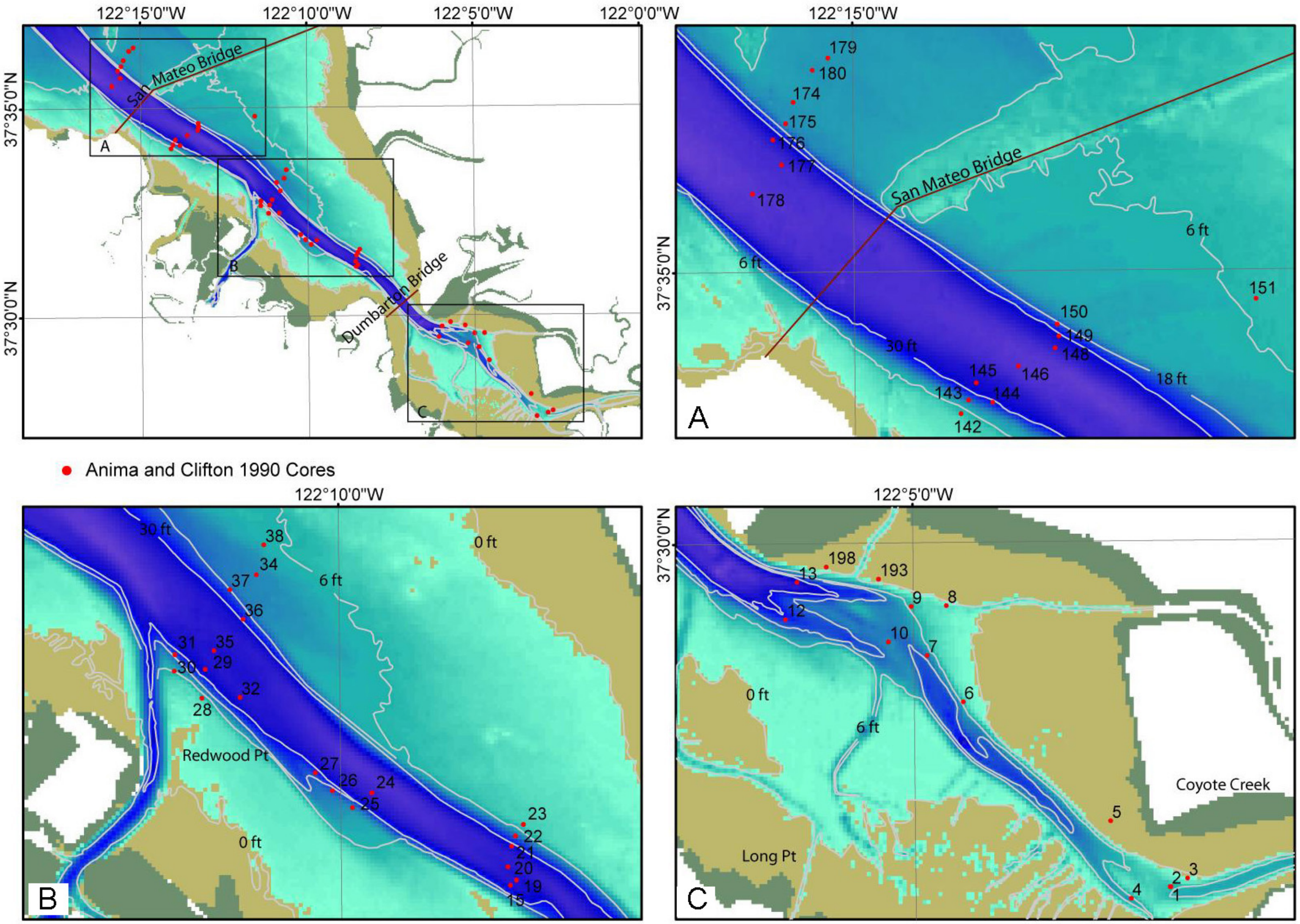

Figure 2. Maps showing locations of Anima and Clifton cores in the south bay (Anima and others, 2005). Bathymetric data from Foxgrover and others (2007).

Main Features of the Sediments

Lithology

Most of the cores penetrate horizontally laminated, soft, silty clays and clayey silts. Strata of sand are thin and rare. Silt and sand laminae show a sharp bottom contact and grade upward into fine silts or silty clays. Deformed or convoluted strata are rare. Some cores collected on channel walls include strata inclined at 10–15° angles, which are best explained by slumping or accretion on the channel wall. Inclined strata that maintain a uniform dip direction, either in core segments or through an entire core, are not likely to be an artifact of coring.

Grain Size

Small sediment samples were analyzed with a grain-size comparator but as logging proceeded, grain-size estimates were made by eye. Although subjective, such analyses are rapid and reproducible. Useful as these analyses may be, only instrumental analyses of grain size can resolve subtle changes in fine sand or silt percentage in this otherwise clay-rich sequence.

Particle-size analyses were accomplished following standardized procedures using a Beckman Coulter LS230 Laser-Diffraction Particle Size Analyzer at the USGS Sediment Laboratory in Menlo Park, California. Thirty-seven samples were selected for analysis, representing the sediment types most often found in the cores. Results are reported in histograms (fig. 3) and as descriptive statistics (appendix 1). The purposes of these analyses are to "calibrate" visual grain-size estimates, and to compare the grain size of samples from cores with the grain size of surficial samples from the south bay (Foxgrover and others, 2004), thereby providing an additional basis for environmental interpretation of the cored sediments.

Figure 3 provides grain-size histograms of the four types of sediment recognized in the cores: sand, silty sand, clayey silt and silty clay. The grain sizes of coquina and shell-rich sediment were not part of this analysis. Clayey silts make up about two-thirds of the cored sediment.

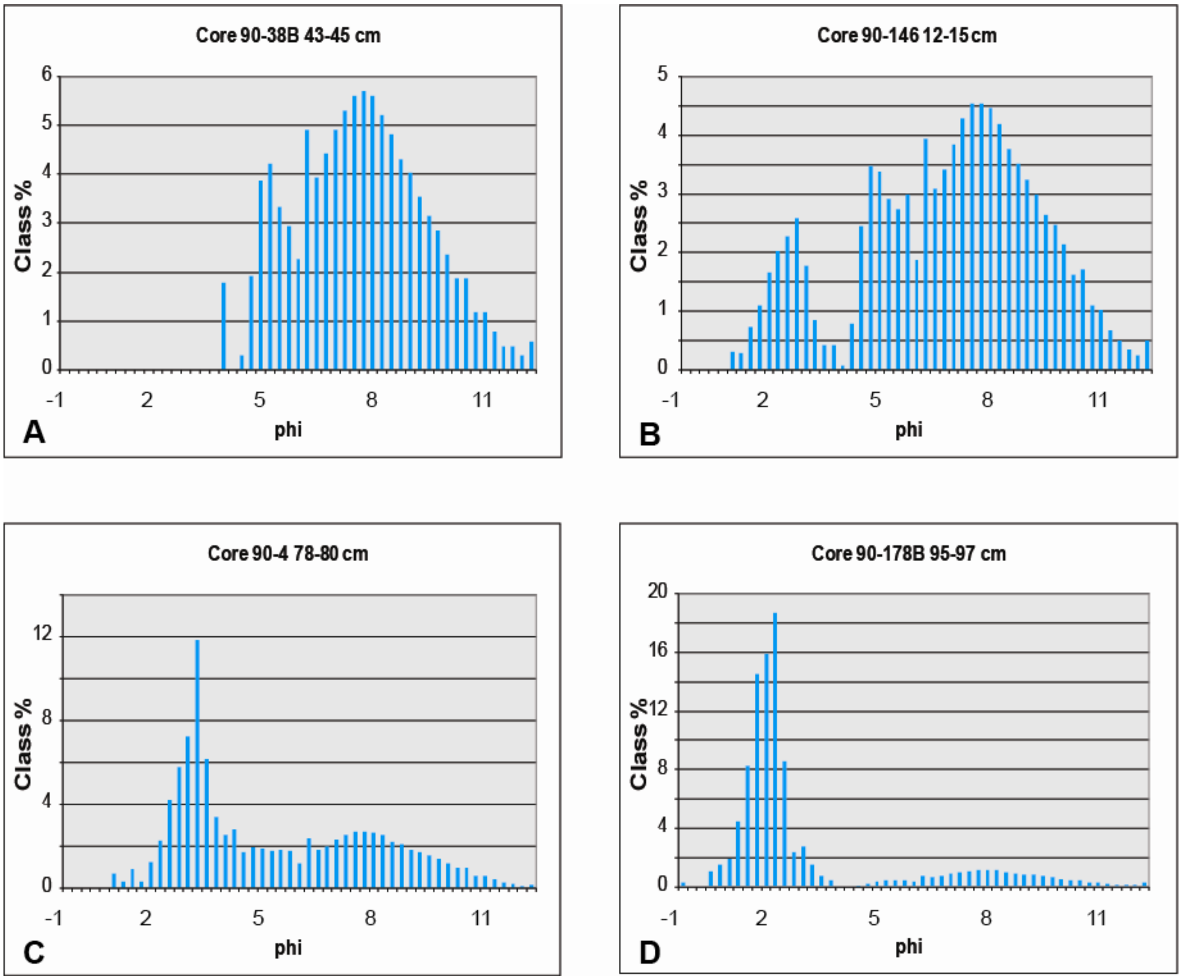

Figure 3. Histograms of typical grain-size distributions. *A* is representative of clayey silt. *B* is sandy silt. *C* is silty sand. *D* is sand.

Sedimentary Structures

The predominant sedimentary structure in all cores is lamination, a characteristic feature of many fine-grained estuarine sediments (Friedman and others, 1992). A single core may display lamination ranging from tightly spaced, clearly defined microlaminae less than a millimeter thick to weakly defined laminae a few millimeters (rare) to one centimeter thick (common). In X-radiographs, laminae apparently composed of fine sand or silt are light colored and grade upward into darker gray, thicker laminae thought to be clayey silt (fig. 4). Laminae at the bottom of the graded sequences rest on a sharply defined erosion surface. The presence of laminae suggests both deposition by weak currents and little bioturbation. Thicker laminae probably are the result of sediment mixing during bioturbation.

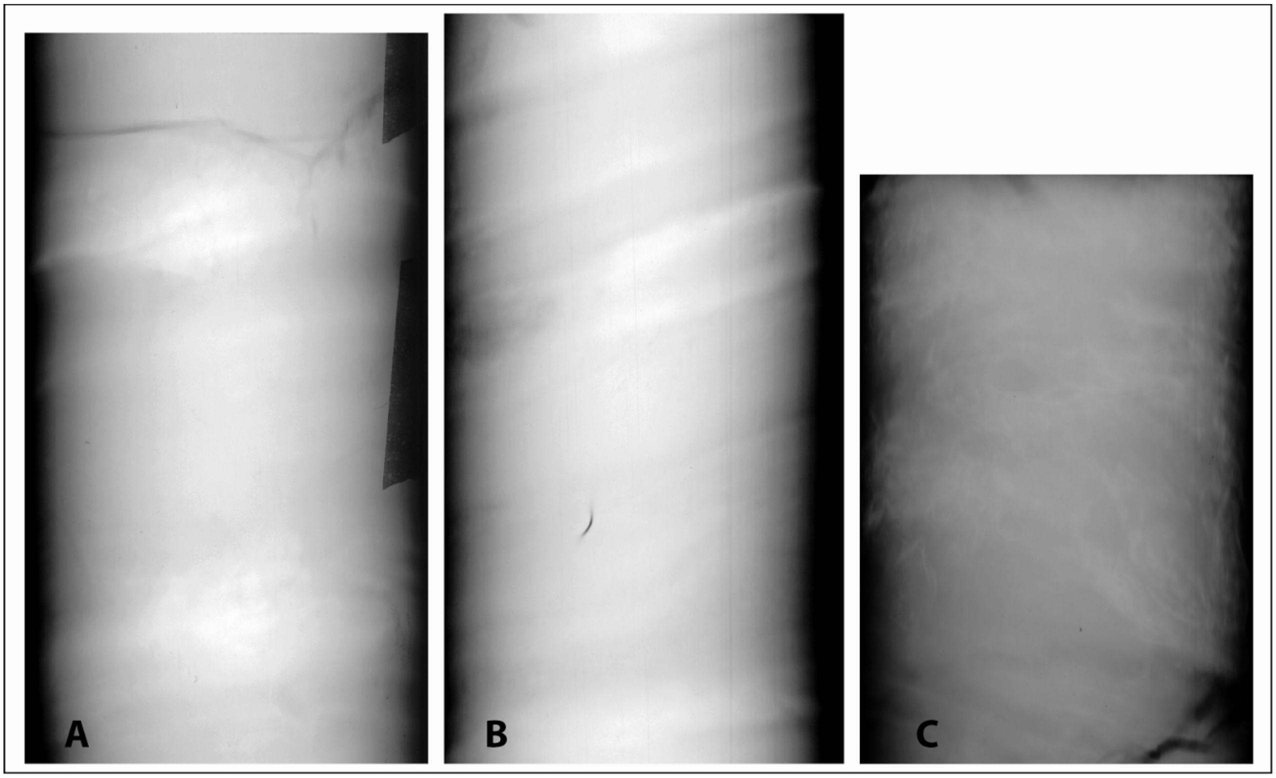

Figure 4. X-radiographs showing *A*, Inclined strata, core 90-34 from 110 to 130 cm. *B*, Inclined strata with cut-and-fill structures, core 90-34 from 64 to 80 cm. *C*, Disturbed strata, core 90-151 from 0 to 13 cm.

Erosion surfaces of many types and scales are seen in X-adiographs but split cores display only the most obvious examples. Erosion surfaces in both split cores and X-radiographs are defined by changes in color or grain size or the juxtaposition of horizontal strata over tilted strata. Disarticulated, size-sorted shell material (coquina) is often bound by a clayey silt erosion surface above or below. Subtle erosion surfaces are likely missed during the logging of split cores because changes in grain size or color across such an erosion surface may be impossible to resolve even with a hand lens.

Attempts to use erosion surfaces as guides to correlate strata in adjacent cores were not successful in the absence of carbon-14 dates or other distinctive features traceable between cores. This lack of correspondence is taken to indicate that most, and perhaps all, erosion surfaces formed in response to localized processes. Correlation based on other sedimentary features or sedimentary sequences has not been attempted.

Cross-laminae associated with cut-and-fill structures are found in the clays and silts. All are small with relief of about 1 cm, either as a depth of erosion in cut-and-fill structures or as small ripples. Some of the cross-laminae show dip reversal demonstrating variation in the direction of depositing currents usually associated with tidal activity.

Shell Material

Hart (1966) pointed out the shell-rich nature of sediments at many locations while Travis and Goeden (2010) reported on shell mining in the south bay. Results from this study mirror what has been reported by those authors. Shell material is found in most cores and approximately 50 percent of the cores contain oyster coquinas in strata 1–2 cm thick. Several cores (90-22, 90-22, 90-144) are made up entirely of whole and broken size-sorted shells (fig. 5A). An additional 10 percent of cores include articulated (fig. 5B) or disarticulated oyster shells and the shells of other bivalves scattered in clayey silt. Gastropod shells (fig. 5C) are rare at all locations but they are more common in cores collected south of the Dumbarton Bridge. Shell species were not identified in this study.

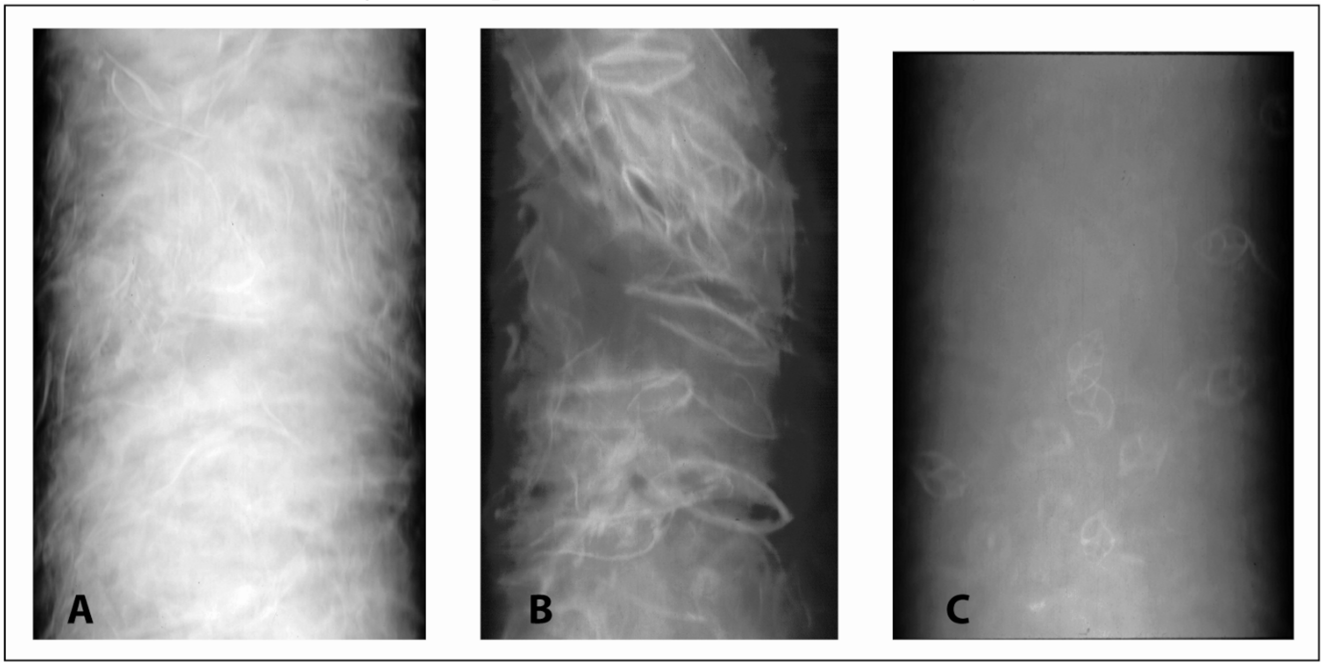

Figure 5. X-radiographs showing shelly sediment. *A*, Coquina of broken bivalve shells, core 90-21 from 49 to 71 cm. *B*, Articulated bivalve shells, core 90-24 at from 69 to 87 cm. *C*, Gastropod shells, core 90-3 from 74 to 86 cm.

Coquinas are found in distinctive sequences as thick as 10 cm. In cores made up entirely of coquina, sequences are not well organized. A greater degree of organization is seen where layers of coquina are scattered through a muddy sequence. The basal strata of coquina sequences are silty clays containing whole, articulated shells 1–3 cm across, some in life position. These shelly, silty clays rest on erosion surfaces. Above these strata, shells are thin, angular, 1- to 2-cm-long plates, tightly packed, and weakly oriented, in a muddy mass. At the top of coquina sequences small, platy shell fragments a few millimeters across are aligned parallel to bedding, and they are tightly packed with little mud.

Trace Fossils

Intense bioturbation with well-defined trace fossils might be expected as a pervasive feature of these estuarine sediments (Seilacher, 2007). Instead, well-developed laminae are ubiquitous, suggesting that bioturbation is limited. The relative lack of bioturbation may be explained by the location of the cores in or near the main channel. However, thicker laminae may include bioturbated sediment in which the original stratification has been eliminated.

About two-thirds of the cores have distinctive, well-defined burrows that cut vertically through laminae without much disturbance. These burrows appear to have been produced by the maldanid polychaete *Sebaco elongatus*, as identified by Jan Thompson (USGS, oral commun., 2005). The burrows are 10–60 cm long, and straight to broadly curved. Tube diameters are approximately 2–3 mm, with wall thicknesses equal to about one-fifth of the diameters (fig. 6). Individual burrows start at modern sediment interfaces or at erosion surfaces and abruptly end downcore at the top of coquina or silty/sandy strata.

Figure 6. X-radiograph of *Sebaco elongatus* burrows, Core 90-8 at approximately 5 cm.

Thompson reports that *S. elongatus* was introduced to San Francisco Bay Estuary in the 20th century. None of the cores described here contain burrows packed as tightly as Thompson has seen elsewhere in the bay. Instead, in the south bay, these burrows are clearly separate from one another.

A second burrow type seen in many cores is shorter than the burrows made by *S. elongatus* (fig. 7). The shorter burrows have a greater diameter and a less regular pattern than those attributed to *S. elongatus*. The unknown burrowers penetrated to depths of 5–10 cm in the sediment, and they cut through laminae but did not otherwise disturb the sediment.

Burrows of both types originate at erosion surfaces and extend downward. Sediment above erosion surfaces with *S. elongatus* burrows was deposited after *S. elongatus* was introduced in the past century.

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Figure 7. X-radiograph of burrows made by an unknown organism. Core 90-2 from 71 to 86 cm.

Age of Sediments

A total of 26 accelerator mass spectrometry radiocarbon dates (table 1) are reported here. Dates from 20 A/C cores come from bivalve shells as described below. Story and others (1966) reported seven additional radiocarbon dates from drill cores obtained near the San Mateo Bridge. Those dates were based on peats and shell material. The 26 dates from A/C cores were used for the following purposes: (1) to determine the time spanned by the sediments, (2) as a basis for calculating sedimentation rates, and (3) to provide a basis for assessing synthetic cores devised by Foxgrover and others (2004) from data on the changing bathymetry of the south bay since 1850.

Shells thought to have undergone no erosion or transport after death of the organisms were selected from the A/C cores, washed free of sediment, and shipped in glass bottles to Woods Hole Oceanographic Institution for analysis at the National Ocean Sciences Accelerator Mass Spectrometer Facility. The reported dates were calibrated using CALIB software (Stuiver and others 1998) and a reservoir correction of 323±52 years as reported by McGann (2008).

To test the hypothesis that shells selected for ^{14}C analysis were in place, the ^{14}C ages were plotted against depth in the core (fig. 8). The expected pattern of increasing age with depth is illustrated by all but two samples. The sample from core 90-142A at a depth of 71 cm yielded an isotopic age of 715 years but it is found 10 cm below an older sample. A sample from core 90-178 at a depth of 1 m yielded an isotopic age of 7,280 years while all other samples from that depth or deeper yield isotopic ages of 5,200 years or less. Those two dates have been omitted from computations of sedimentation rates.

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Table 1. Radiocarbon dates with calibration.

[Radiocarbon dates calibrated using CALIB software (Stuiver and others, 2010). SWW, synthetic cores ; A/C, Anima and Clifton cores.]

	Core number	Material	Depth in core (cm)	C14 age	±	Calibrated Age
SWW	1	Shell	61	2420	180	1696
	2	Shell	152	2300	150	1550
	3	Shell	975	5730	220	1825
	4	Peat	595	4658	200	4510
	5	Peat	610	5815	200	5891
	6	Peat	701	6150	275	6242
	7	Peat	1539	7360	320	7557
A/C	90-24	Shell	46	1220	35	537
	90-24	Shell	74	1600	30	829
	90-24	Shell	141	1760	35	1006
	90-28	Shell	37	1120	35	435
	90-28	Shell	108	2000	30	1860
	90-30	Shell	241	2060	40	1306
	90-36	Shell	106	1650	35	873
	90-36	Shell	118	1920	40	1168
	90-36	Shell	309	3650	35	3204
	90-36	Shell	336	5200	35	5179
	90-142	Shell	129	2120	35	1357
	90-150	Shell	181	1290	35	574
	90-151	Shell	149	3580	45	3004
	90-177	Shell	86	1140	35	451
	90-178	Shell	113	7280	45	748
	90-10	Shell	75	625	30	Invalid for calibration (Stuiver and others, 2010)
	90-31	Shell	64	735	30	
	90-142	Shell	61	755	20	
	90-142	Shell	71	715	25	
	90-142	Shell	92	765	30	

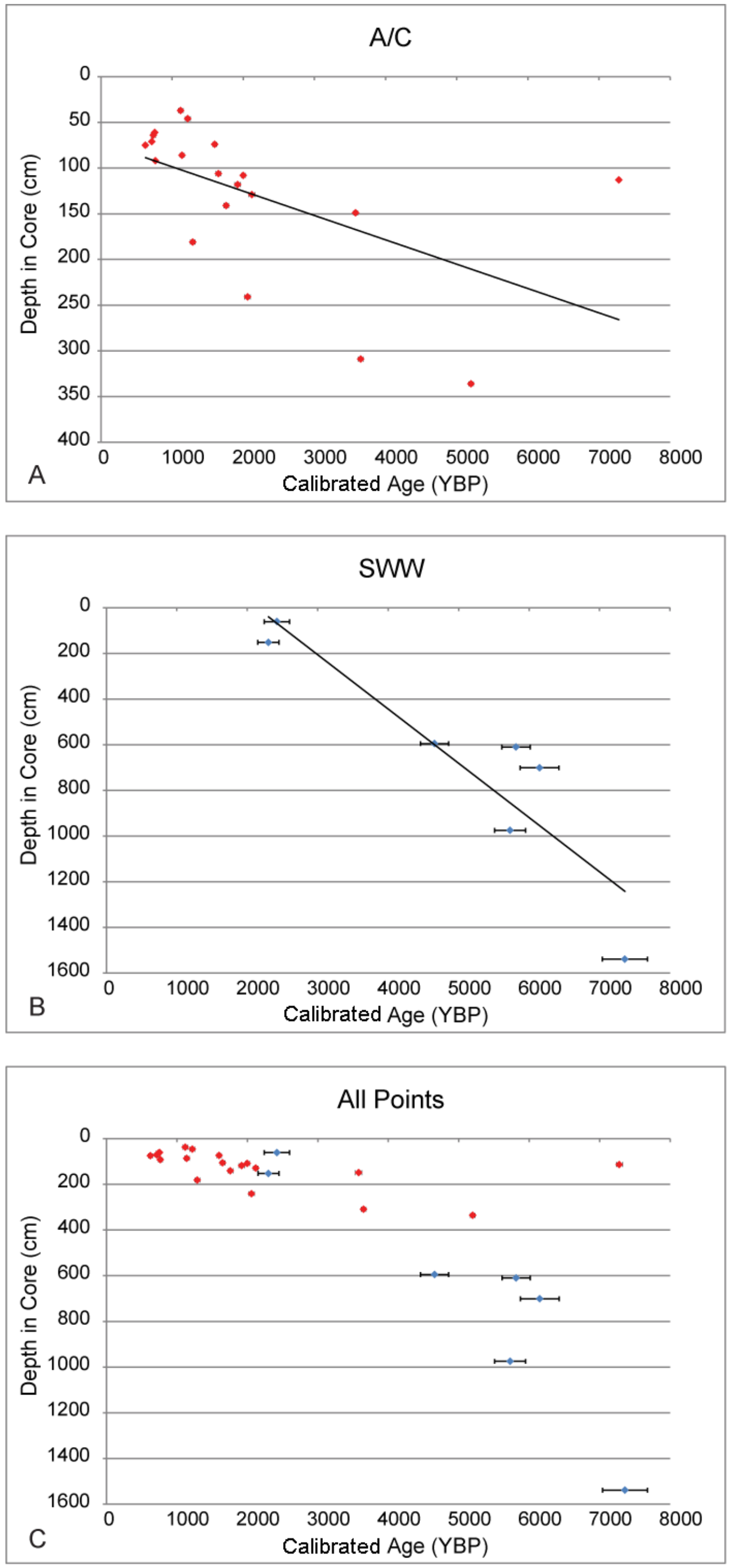

Figure 8. Plots showing calibrated age versus depth in core. *A*, Anima and Clifton cores (A/C). *B*, Synthetic cores (SWW). *C*, All cores.

Story and others (1966) provide additional radiocarbon dates (table 1) in their study of sediment at seven locations a few kilometers north and south of the San Mateo Bridge. Procedures used to collect and analyze the materials were not reported. Analyses were performed by Teledyne Corporation. Two of the samples come from the top part of shell-bearing strata at depths of 0.6 m (2 ft as reported by Story and others, 1966) and 1.6 m (5 ft), and 5 other samples come from as deep as 15 m (50 ft) below the sediment interface. Peat sampled by the longer cores probably formed along the bay margin as it was reflooded during the Holocene sea level rise (Atwater and others, 1977). As with radiocarbon dates from the A/C cores, dates from these cores show the expected increase of age with depth in the core (fig. 8).

Sedimentation Rates

Curves fitted to the two sets of data in figure 8 illustrate sedimentation rates over the past 7,000 years in the south bay. Deposition rates in the south bay over the past 6–7,000 years appear to have decreased sharply at approximately 2.2 ka. From ~7–2 ka sediment was deposited at rates in excess of 2 mm/yr, whereas younger sediment (<2 ka) was deposited at 0.4 mm/yr, one-fifth the previous rate. The cause of this change in rate is unknown.

Rates of deposition reported at the decadal level at various locations within the south bay by Foxgrover and others (2004) are comparable to the slower rate reported here. Faster rates of deposition reported here apply to sediments older than those discussed by Foxgrover and others.

Split Cores and Synthetic Cores

Split Cores

With the exception of core 90-151 (fig. 2, appendix 1), which was taken on a mudflat 1.5 km east of the main channel, A/C cores were obtained at locations either associated with vaguely defined, meander-like features referred to here as “incipient meanders” or in 1- to 2-km-long scour features on the channel floor.

Cores from the convex side of incipient meanders have thick laminae, relatively few shells, and few examples of inclined strata and cross-strata with dip reversals. Cores taken on the concave sides of incipient meanders exhibit thick laminae, coquina, and instances of cross-strata with dip reversals.

Several cores are available from the base of the channel. Core 90-177 (fig. 2, appendix 1) is typical, showing many erosion surfaces and shell material in a sandy matrix. Other channel cores display size-sorted coquinas and the few strata of fine, relatively well sorted sand encountered in this study.

Core 90-151 contains the only example of sedimentary patterns developed at a location distant from the channel. The core shows thick sandy and silty laminae, some of them inclined. Based on the thickness of inclined strata in this core, the corer likely penetrated sediments deposited in a mudflat channel at least 1 m deep. The age of that channel is unknown.

Synthetic Cores

Foxgrover and others (2004) analyzed bathymetric data for the south bay over the period 1858–1983 and prepared a series of maps showing changes in bathymetry between surveys. After correcting for subsidence and tectonic effects, the maps illustrate accretion or erosion between surveys. Using the methodology created by Higgins and others (2005), the bathymetric data were used to create logs of Predicted Sediment Chronology (referred to here as synthetic cores). Eight synthetic cores were prepared for selected gravity core sites showing sediment thickness and survey dates. Logs showing sediment thickness and the placement of bathymetric survey dates determined by Higgins and others (2005) are found in appendix 2.

Table 2. Synthetic cores created for this study.

Gravity Cores	Synthetic Cores	Location
90-28	90-28s	Outside of meander (?)
90-30	90-30s	Inside of meander
90-31	90-31s	Inside of meander
90-36	90-36s	Outside of meander
90-150	90-150s	Outside of meander
90-151	90-151s	Mudflat, east of channel
90-177	90-177s	Inside of meander
90-178	90-178s	Scour on channel floor

Sedimentation Rates Determined from Synthetic Cores

Synthetic cores prepared for core locations 90-30, 90-151, 90-177, and 90-178 predict less than 25 cm of sediment accretion over a period of 40–140 years. Radiocarbon dates from the gravity cores from those same locations are positioned 60–140 cm below the base of the synthetic cores. Therefore, no discrepancy exists between the data from the gravity and synthetic cores at those locations.

Comparing the record in gravity cores with that of synthetic cores for core locations 90-28, 90-31, 90-36, 90-150 does not lead to such easy resolution. Each of the synthetic cores spans the 140-year period before the present, but radiocarbon dates of 735 years to as old as 5,200 years appear to be "too old" suggesting, perhaps, that shells on which the ages are based were eroded from older strata.

Discussion and Summary

Since sea level approached its modern level 5–7 ka, the south bay has been an estuary with roughly its modern configuration (Atwater and others, 1979). Most of the shore was originally made up of wetlands separated by small deltas (Atwater and others, 1977, Folger, 1972), and the southernmost part of the bay was dominated by the delta of the Guadalupe River. The shore of the south bay has been modified greatly since the arrival of Europeans; salt evaporators, residential and industrial developments, airports, and ports have replaced nearly all of the wetlands.

In contrast to what has happened along the shore, there has been little change where core samples were taken in the open bay. Silty and sandy clays and shelly sediments are typical over most of the floor of the modern-day south bay and the cores demonstrate the same pattern. Throughout the few thousand years recorded in the cores, clayey silt has been deposited over most of the bay floor with sand restricted to the main channel. Coquinas and other shelly sediments have a more limited distribution just north of and south of the San Mateo Bridge and, to a lesser extent, near the main channel opposite Redwood and Ravenswood Points. This same coquina distribution is seen in the cores.

Sediments sampled by the A/C cores provide a record of sedimentary facies spanning the most recent of the thousands of years of San Francisco Bay history. The type and location of these ancient facies look to be very similar to those seen in the modern day south bay indicating that tectonics (Rogers and Figuers, 1992), subsidence due to groundwater withdrawal (Poland and Ireland, 1988), and other cultural developments have not greatly affected the character and distribution of sedimentary environments in the open bay during the time spanned by the cores.

Acknowledgments

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Appendix 1. Grain Size Data.

Histograms for samples 90-38B, 43-45 cm; 90-146, 12-15 cm; 90-4, 78-80 cm; and 90-178B, 95-97 cm are in Figure 3.

Core ID's	Folk and Ward (phi)					Inman (phi)						Trask (mm)				
	Median	Mean	Sorting	Skew	Kurtosis	Median	Mean	Sorting	Skew1	Skew2	Kurtosis	Median	Mean	Sorting	Skewness	Kurtosis
Core 90-4(Bottom part) 80-82 cm	6.22	6.01	2.54	-0.03	0.62	6.22	5.91	2.89	-0.11	0.05	0.26	0.01	0.05	5.30	2.10	0.38
Core 90-4(Bottom part) 130-132 cm	3.05	4.07	1.95	0.79	2.79	3.05	4.58	1.87	0.82	1.37	0.79	0.12	0.10	1.40	0.64	0.20
Core 90-8A 80-85 cm	7.33	7.29	1.95	0.04	0.83	7.33	7.27	2.11	-0.03	0.15	0.41	0.01	0.01	2.75	1.10	0.24
Core 90-8B 18-20 cm	7.30	7.22	1.92	-0.02	0.84	7.30	7.17	2.07	-0.06	0.03	0.42	0.01	0.01	2.70	1.20	0.22
Core 90-8B 80-82 cm	7.58	7.55	1.82	0.02	0.92	7.58	7.53	1.91	-0.03	0.11	0.49	0.01	0.01	2.42	1.04	0.20
Core 90-12(Bottom part) 30-32 cm	7.22	7.12	1.99	-0.04	0.83	7.22	7.06	2.13	-0.08	-0.01	0.44	0.01	0.01	2.83	1.28	0.23
Core 90-12(Bottom part) 60-62 cm	1.89	2.57	3.59	0.33	1.13	1.89	2.91	4.10	0.25	0.51	0.24	0.27	0.24	3.58	0.21	0.07
Core 90-12(Top part) 28-30 cm	7.40	7.32	1.93	-0.01	0.87	7.40	7.28	2.06	-0.06	0.05	0.44	0.01	0.01	2.64	1.12	0.21
Core 90-23A 82-84 cm	7.31	7.27	1.97	0.01	0.86	7.31	7.24	2.10	-0.03	0.09	0.45	0.01	0.01	2.75	1.12	0.22
Core 90-23B 10-12 cm	7.65	7.56	1.80	-0.05	0.88	7.65	7.52	1.93	-0.07	-0.03	0.44	0.00	0.01	2.46	1.10	0.19
Core 90-38A 38-40 cm	7.45	7.37	1.97	0.00	0.91	7.45	7.33	2.09	-0.06	0.07	0.45	0.01	0.01	2.57	1.05	0.19
Core 90-38A 100-102 cm	7.26	7.19	1.93	0.01	0.85	7.26	7.16	2.07	-0.05	0.09	0.43	0.01	0.01	2.68	1.16	0.23
Core 90-38B 20-22 cm	7.34	7.30	1.87	0.02	0.86	7.34	7.27	2.00	-0.04	0.11	0.43	0.01	0.01	2.57	1.08	0.22
Core 90-142A 37-39 cm	7.50	7.44	1.92	0.00	0.94	7.50	7.41	2.01	-0.05	0.06	0.50	0.01	0.01	2.48	1.04	0.18
Core 90-142A 130-132 cm	6.24	6.36	2.05	0.08	0.97	6.24	6.42	2.01	0.09	0.13	0.72	0.01	0.02	2.74	0.95	0.19
Core 90-142B 20-22 cm	6.65	6.64	2.22	-0.02	0.96	6.65	6.63	2.22	-0.01	-0.06	0.66	0.01	0.02	2.98	1.13	0.14
Core 90-142B 45-46 cm	4.99	5.19	2.75	0.16	0.67	4.99	5.3	3.05	0.10	0.30	0.33	0.03	0.09	5.64	1.03	0.37
Core 90-142B 47-48 cm	2.99	4.34	2.77	0.64	0.70	2.99	5.01	3.04	0.66	0.85	0.36	0.13	0.11	5.38	0.10	0.35
Core 90-146 55-56 cm	1.90	1.47	1.93	-0.18	4.29	1.90	1.26	1.13	-0.57	0.84	2.97	0.27	0.31	1.35	1.23	0.04
Core 90-146 100-102 cm	6.16	6.34	2.18	0.15	0.81	6.16	6.43	2.27	0.12	0.26	0.51	0.01	0.03	3.35	1.00	0.29
Core 90-151A 40-42 cm	7.02	7.10	1.96	0.11	0.79	7.02	7.14	2.13	0.05	0.23	0.40	0.01	0.01	2.91	1.02	0.28
Core 90-151A 60-65 cm	7.56	7.58	1.78	0.05	0.92	7.56	7.59	1.85	0.01	0.14	0.52	0.01	0.01	2.39	0.98	0.21
Core 90-151B 56-58 cm	6.38	6.69	1.89	0.29	0.80	6.38	6.84	2.02	0.23	0.49	0.43	0.01	0.02	2.81	0.74	0.33
Core 90-151B 80-85 cm	5.91	6.25	2.03	0.29	0.77	5.91	6.42	2.17	0.23	0.49	0.43	0.02	0.02	3.12	0.74	0.36
Core 90-178A 69-70 cm	7.05	7.02	2.34	-0.12	1.19	7.05	7.01	2.11	-0.02	-0.42	1.01	0.01	0.01	2.76	1.13	0.05
Core 90-178B 50-52 cm	2.44	4.07	2.80	0.77	0.65	2.44	4.88	3.12	0.78	1.01	0.31	0.18	0.13	5.94	0.06	0.40
Core 90-180A 60-62 cm	7.02	6.93	1.99	0.00	0.82	7.02	6.88	2.14	-0.07	0.10	0.42	0.01	0.01	2.85	1.29	0.23
Core 90-180A 108-110 cm	6.03	5.99	2.32	0.03	0.86	6.03	5.96	2.46	-0.03	0.12	0.47	0.02	0.03	3.28	1.07	0.21
Core 90-180B 28-30 cm	4.68	4.93	2.67	0.19	0.68	4.68	5.06	2.95	0.13	0.35	0.34	0.04	0.10	5.28	0.92	0.37

Core ID's	Folk and Ward (phi)					Inman (phi)						Trask (mm)				
	Median	Mean	Sorting	Skew	Kurtosis	Median	Mean	Sorting	Skew1	Skew2	Kurtosis	Median	Mean	Sorting	Skewness	Kurtosis
Core 90-180B 73-75 cm	6.49	6.58	2.15	0.04	0.97	6.49	6.62	2.12	0.06	0.04	0.70	0.01	0.02	2.87	1.00	0.22
Core 90-180B 122-124 cm	8.03	8.13	1.43	0.11	0.96	8.03	8.19	1.45	0.11	0.18	0.61	0.00	0.00	1.99	0.87	0.23

Core ID's	% Classes					Ratios						Mmnt Std. Dev Var				
	% Gravel	% Sand	% Silt	% Clay	% Mud	Grvl/Sand	Sand/Silt	Silt/Clay	Sand/Clay	Sand/Mud	Grvl/Mud	1st mmnt	Variance	Std. Dev.	3rd mmnt	4th mmnt
Core 90-4(Bottom part) 80-82 cm	0.00	33.52	40.14	26.34	66.48	0.00	0.83	1.52	1.27	0.50	0.00	6.01	6.30	2.51	0.10	1.69
Core 90-4(Bottom part) 130-132 cm	0.00	76.08	14.89	9.03	23.92	0.00	5.11	1.65	8.42	3.18	0.00	4.00	4.50	2.12	1.76	5.06
Core 90-8A 80-85 cm	0.00	0.54	62.46	37.00	99.46	0.00	0.01	1.69	0.01	0.01	0.00	7.38	3.65	1.91	0.38	2.61
Core 90-8B 18-20 cm	0.00	1.19	63.09	35.72	98.81	0.00	0.02	1.77	0.03	0.01	0.00	7.26	3.29	1.81	0.06	2.10
Core 90-8B 80-82 cm	0.00	0.86	58.49	40.65	99.14	0.00	0.01	1.44	0.02	0.01	0.00	7.63	3.23	1.80	0.35	2.90
Core 90-12(Bottom part) 30-32 cm	0.00	4.45	61.04	34.51	95.55	0.00	0.07	1.77	0.13	0.05	0.00	7.11	3.73	1.93	-0.08	2.27
Core 90-12(Bottom part) 60-62 cm	19.72	53.83	16.34	10.10	26.45	0.37	3.29	1.62	5.33	2.04	0.75	2.66	11.00	3.32	0.75	2.77
Core 90-12(Top part) 28-30 cm	0.00	0.83	61.40	37.76	99.17	0.00	0.01	1.63	0.02	0.01	0.00	7.38	3.52	1.88	0.16	2.51
Core 90-23A 82-84 cm	0.00	1.09	62.32	36.59	98.91	0.00	0.02	1.70	0.03	0.01	0.00	7.34	3.74	1.93	0.29	2.59
Core 90-23B 10-12 cm	0.00	0.83	57.05	42.12	99.17	0.00	0.01	1.35	0.02	0.01	0.00	7.58	3.04	1.74	-0.20	2.68
Core 90-38A 38-40 cm	0.00	1.39	59.94	38.67	98.61	0.00	0.02	1.55	0.04	0.01	0.00	7.46	3.68	1.92	0.27	2.66
Core 90-38A 100-102 cm	0.00	0.99	64.12	34.89	99.01	0.00	0.02	1.84	0.03	0.01	0.00	7.26	3.45	1.86	0.24	2.42
Core 90-38B 20-22 cm	0.00	0.50	62.98	36.52	99.50	0.00	0.01	1.72	0.01	0.00	0.00	7.37	3.27	1.81	0.26	2.44
Core 90-142A 37-39 cm	0.00	3.11	57.45	39.43	96.89	0.00	0.05	1.46	0.08	0.03	0.00	7.51	3.59	1.89	0.22	2.76
Core 90-142A 130-132 cm	0.00	11.69	67.13	21.18	88.31	0.00	0.17	3.17	0.55	0.13	0.00	6.36	4.26	2.06	0.37	2.88
Core 90-142B 20-22 cm	0.00	11.81	61.16	27.03	88.19	0.00	0.19	2.26	0.44	0.13	0.00	6.60	4.72	2.17	0.04	2.45
Core 90-142B 45-46 cm	0.00	40.96	39.77	19.28	59.04	0.00	1.03	2.06	2.12	0.69	0.00	5.21	7.76	2.79	0.40	2.03
Core 90-142B 47-48 cm	0.00	53.77	29.77	16.46	46.23	0.00	1.81	1.81	3.27	1.16	0.00	4.57	8.15	2.86	0.61	2.03
Core 90-146 55-56 cm	14.23	75.89	6.28	3.61	9.89	0.19	12.09	1.74	21.03	7.68	1.44	1.90	5.31	2.30	1.36	6.38
Core 90-146 100-102 cm	0.36	11.92	63.94	23.79	87.73	0.03	0.19	2.69	0.50	0.14	0.00	6.25	5.35	2.31	0.07	2.89
Core 90-151A 40-42 cm	0.00	0.63	65.99	33.38	99.37	0.00	0.01	1.98	0.02	0.01	0.00	7.16	3.70	1.92	0.41	2.40
Core 90-151A 60-65 cm	0.00	0.70	58.89	40.42	99.30	0.00	0.01	1.46	0.02	0.01	0.00	7.65	3.12	1.77	0.40	2.95
Core 90-151B 56-58 cm	0.00	0.65	73.22	26.14	99.35	0.00	0.01	2.80	0.02	0.01	0.00	6.76	3.55	1.88	0.67	2.66
Core 90-151B 80-85 cm	0.00	6.30	71.52	22.17	93.70	0.00	0.09	3.23	0.28	0.07	0.00	6.30	4.15	2.04	0.64	2.55
Core 90-178A 69-70 cm	0.00	12.87	55.01	32.12	87.13	0.00	0.23	1.71	0.40	0.15	0.00	6.81	5.94	2.44	-0.44	2.98
Core 90-178B 50-52 cm	0.00	54.82	29.23	15.95	45.18	0.00	1.88	1.83	3.44	1.21	0.00	4.43	8.79	2.96	0.62	1.99
Core 90-180A 60-62 cm	0.00	3.91	65.03	31.06	96.09	0.00	0.06	2.09	0.13	0.04	0.00	6.97	4.02	2.01	0.09	2.72
Core 90-180A 108-110 cm	0.00	19.19	59.91	20.90	80.81	0.00	0.32	2.87	0.92	0.24	0.00	6.07	5.11	2.26	0.30	2.46
Core 90-180B 28-30 cm	0.00	43.77	40.18	16.05	56.23	0.00	1.09	2.50	2.73	0.78	0.00	4.94	7.31	2.70	0.46	2.06
Core 90-180B 73-75 cm	0.00	10.25	64.50	25.25	89.75	0.00	0.16	2.55	0.41	0.11	0.00	6.56	4.45	2.11	0.17	2.57
Core 90-180B 122-124 cm	0.00	0.00	49.20	50.80	100.00	0.00	0.00	0.97	0.00	0.00	0.00	8.16	2.09	1.45	0.43	3.19

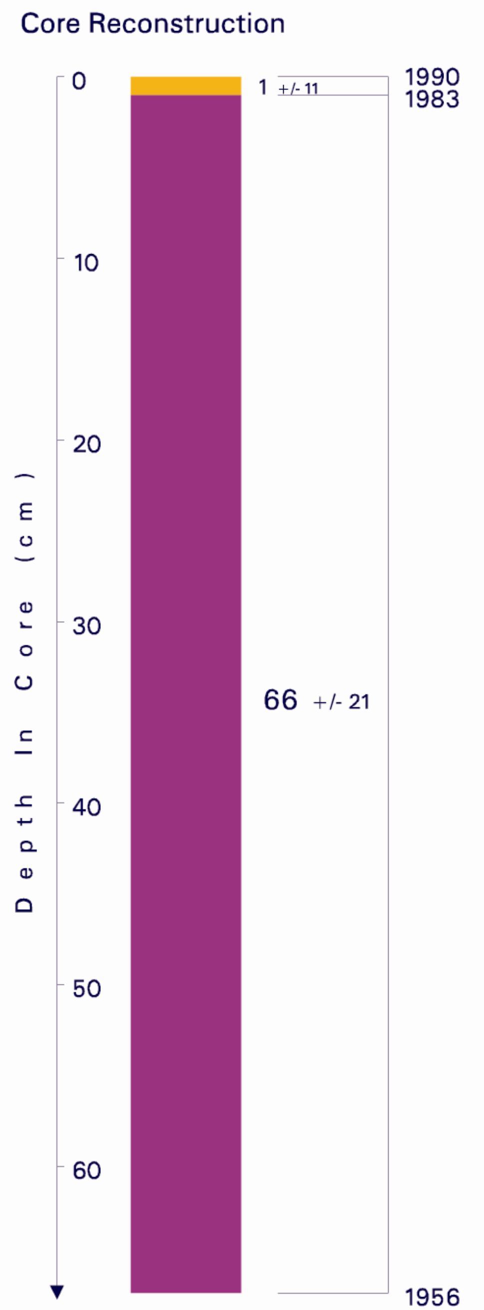
Sample ID's	Phi % / Sand																
	-1	0	0.3	0.5	0.8	1	1.3	1.5	1.75	2	2.25	2.5	2.8	3	3.25	3.5	3.8
Core 90-4(Bottom part) 80-82 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	1.17	4.00	9.52	9.00	5.48	2.41
Core 90-4(Bottom part) 130-132 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10	3.39	5.21	7.81	19.89	27.07	7.02	2.53
Core 90-8A 80-85 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Core 90-8B 18-20 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Core 90-8B 80-82 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Core 90-12(Bottom part) 30-32 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.13	0.35	0.65	0.94	1.03	0.83
Core 90-12(Bottom part) 60-62 cm	19.72	0.00	0.00	0.00	0.75	1.72	5.17	6.57	9.15	12.54	10.07	4.25	1.72	0.92	0.43	0.54	0.00
Core 90-12(Top part) 28-30 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.01	0.00	0.04	0.07	0.05	0.09	0.09	0.11	0.09
Core 90-23A 82-84 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.19	0.34
Core 90-23B 10-12 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08	0.22	0.05	0.05	0.04	0.04	0.06	0.05	0.05	0.05
Core 90-38A 38-40 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Core 90-38A 100-102 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Core 90-38B 20-22 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Core 90-142A 37-39 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Core 90-142A 130-132 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.11	1.58	2.83	2.22	2.67	1.26
Core 90-142B 20-22 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	1.12	2.55	3.21	2.36	1.41	0.63
Core 90-142B 45-46 cm	0.00	0.00	0.00	0.00	0.00	0.25	0.21	0.87	2.28	4.39	8.12	9.94	7.00	3.40	1.70	1.04	0.95
Core 90-142B 47-48 cm	0.00	0.00	0.00	0.00	0.00	1.22	1.80	3.02	4.24	6.62	10.59	12.55	7.15	2.86	1.17	0.90	0.48
Core 90-146 55-56 cm	14.23	1.44	0.68	0.61	1.82	1.67	3.11	6.68	10.55	17.00	20.94	7.29	2.50	0.99	0.61	0.00	0.00
Core 90-146 100-102 cm	0.36	0.00	0.00	0.00	0.69	0.47	0.69	0.36	0.21	0.36	0.19	0.17	0.23	0.36	0.59	3.14	2.19
Core 90-151A 40-42 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.18
Core 90-151A 60-65 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Core 90-151B 56-58 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Core 90-151B 80-85 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.38
Core 90-178A 69-70 cm	0.00	0.00	0.00	0.00	0.00	0.23	0.51	0.74	1.71	3.01	2.64	1.57	1.02	0.60	0.39	0.21	0.12
Core 90-178B 50-52 cm	0.00	0.00	0.00	0.00	0.00	0.71	1.21	3.95	9.54	13.65	14.25	7.62	2.08	1.10	0.27	0.00	0.44
Core 90-180A 60-62 cm	0.00	0.00	0.00	0.00	0.02	0.20	0.23	0.12	0.06	0.00	0.02	0.06	0.05	0.08	0.19	0.81	1.51
Core 90-180A 108-110 cm	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.26	1.04	1.67	2.06	2.35	4.98	3.49	1.82
Core 90-180B 28-30 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.31	1.19	3.57	7.10	8.95	9.08	5.16	3.13	2.25	1.37	1.06
Core 90-180B 73-75 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.07	0.25	0.67	1.43	2.86	1.69	1.50	1.01
Core 90-180B 122-124 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Sample ID's	Phi % / Silt															
	4	4.25	4.5	4.75	5	5.25	5.5	5.75	6	6.25	6.5	6.75	7	7.25	7.5	7.75
Core 90-4(Bottom part) 80-82 cm	1.66	1.01	0.65	1.93	2.57	2.27	1.90	2.03	1.51	3.08	2.42	2.69	3.21	3.54	3.80	3.80
Core 90-4(Bottom part) 130-132 cm	2.05	1.57	0.62	0.85	0.81	0.68	0.65	0.70	0.47	0.97	0.75	0.88	1.04	1.15	1.24	1.24
Core 90-8A 80-85 cm	0.54	0.13	1.69	4.62	5.79	4.67	3.48	3.58	2.59	5.17	3.58	3.88	4.28	4.58	4.77	4.87
Core 90-8B 18-20 cm	1.19	1.68	3.33	4.12	4.06	3.67	3.47	3.57	2.18	4.66	3.57	4.07	4.46	4.86	5.26	5.06
Core 90-8B 80-82 cm	0.86	0.00	0.18	1.63	3.83	4.38	3.57	2.97	2.18	4.96	3.87	4.16	4.76	5.25	5.65	5.55
Core 90-12(Bottom part) 30-32 cm	0.47	1.46	2.85	4.06	4.24	3.81	3.43	3.43	2.19	4.38	3.34	3.81	4.29	4.77	5.05	4.96
Core 90-12(Bottom part) 60-62 cm	0.00	0.01	0.22	0.74	1.09	1.02	0.85	0.85	0.63	1.35	1.08	1.22	1.35	1.45	1.53	1.51
Core 90-12(Top part) 28-30 cm	0.25	1.16	2.51	3.97	4.23	3.66	3.46	3.56	2.47	4.75	3.56	3.76	4.35	4.75	5.04	5.14
Core 90-23A 82-84 cm	0.55	1.60	3.06	4.06	4.05	3.66	3.56	3.66	2.57	4.94	3.56	3.96	4.35	4.65	4.94	4.85
Core 90-23B 10-12 cm	0.06	0.09	0.56	2.51	4.05	3.77	3.07	2.87	2.18	4.56	3.37	3.77	4.46	5.05	5.45	5.65
Core 90-38A 38-40 cm	1.39	0.50	2.39	4.23	4.29	3.35	2.76	3.16	2.17	4.64	3.65	3.95	4.54	4.83	5.23	5.13
Core 90-38A 100-102 cm	0.99	1.01	3.20	4.71	4.66	3.77	3.47	3.47	2.38	4.86	3.67	4.16	4.56	4.96	5.25	5.05
Core 90-38B 20-22 cm	0.50	0.18	1.63	3.99	5.04	4.38	3.68	3.78	2.59	5.07	3.78	4.08	4.48	4.88	5.17	5.17
Core 90-142A 37-39 cm	3.11	0.06	0.97	2.94	3.91	3.36	2.71	2.91	2.23	4.75	3.78	4.07	4.65	5.04	5.43	5.33
Core 90-142A 130-132 cm	0.92	2.10	3.87	5.67	5.43	4.55	4.20	4.20	2.80	5.69	4.20	4.38	4.29	4.29	4.11	3.76
Core 90-142B 20-22 cm	0.38	2.29	3.03	4.00	4.14	3.79	3.52	3.61	2.47	5.11	3.87	4.05	4.23	4.40	4.40	4.23
Core 90-142B 45-46 cm	0.83	1.11	1.96	3.01	3.10	2.70	2.46	2.40	1.64	3.16	2.34	2.46	2.58	2.75	2.75	2.70
Core 90-142B 47-48 cm	1.18	0.79	1.13	1.58	1.90	1.88	1.79	1.79	1.27	2.59	1.88	2.02	2.12	2.26	2.30	2.26
Core 90-146 55-56 cm	0.00	0.01	0.08	0.26	0.37	0.35	0.30	0.33	0.26	0.59	0.48	0.52	0.55	0.56	0.56	0.53
Core 90-146 100-102 cm	2.28	8.89	5.57	4.81	3.95	3.61	3.44	3.18	1.98	4.12	3.26	3.44	3.61	3.61	3.69	3.52
Core 90-151A 40-42 cm	0.43	0.77	2.73	5.45	6.22	5.25	4.46	4.36	2.87	5.25	3.76	3.86	3.96	4.26	4.36	4.26
Core 90-151A 60-65 cm	0.70	0.00	0.07	1.06	3.14	4.18	3.77	3.28	2.28	5.36	4.17	4.57	5.06	5.36	5.66	5.46
Core 90-151B 56-58 cm	0.65	0.70	4.16	7.93	8.55	6.76	5.27	4.97	3.18	5.76	3.98	3.78	3.68	3.78	3.78	3.48
Core 90-151B 80-85 cm	2.80	12.14	6.83	5.77	4.87	4.51	4.33	3.79	2.25	4.42	3.25	3.25	3.34	3.34	3.25	3.15
Core 90-178A 69-70 cm	0.13	0.09	0.18	1.41	3.19	3.82	3.40	3.31	2.35	5.31	4.09	4.35	4.61	4.79	4.87	4.70
Core 90-178B 50-52 cm	0.00	0.06	0.53	1.35	1.76	1.67	1.81	1.54	1.31	2.76	2.08	2.26	2.35	2.48	2.48	2.44
Core 90-180A 60-62 cm	0.55	4.44	3.78	4.08	4.12	3.64	3.26	3.26	2.21	4.70	3.64	4.12	4.41	4.79	5.08	4.79
Core 90-180A 108-110 cm	1.39	5.43	4.40	4.34	3.86	3.70	3.38	3.13	2.09	4.34	3.46	3.54	3.78	3.78	3.78	3.54
Core 90-180B 28-30 cm	0.62	1.66	2.46	3.01	2.91	2.52	2.46	2.46	1.57	3.19	2.35	2.52	2.63	2.68	2.68	2.63
Core 90-180B 73-75 cm	0.69	2.00	3.65	4.86	4.75	4.39	4.03	4.12	2.69	5.37	4.03	4.12	4.21	4.30	4.21	4.03
Core 90-180B 122-124 cm	0.00	0.00	0.00	0.00	0.07	0.51	1.27	1.91	1.46	3.43	3.25	4.30	5.30	6.30	7.10	7.20

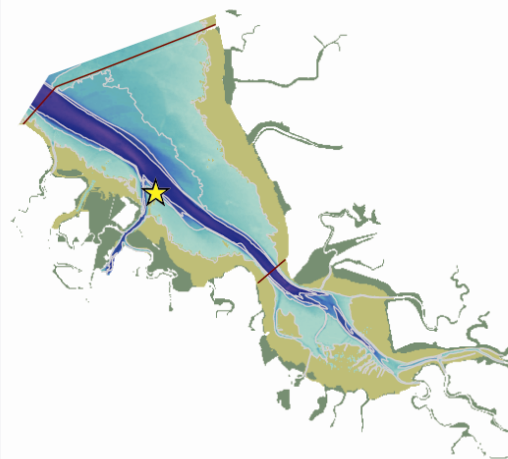
Sample ID's	Phi % / Clay																	
	8	8.25	8.5	8.75	9	9.25	9.5	9.75	10	10.25	10.5	10.75	11	11.25	11.5	11.75	12	14
Core 90-4(Bottom part) 80-82 cm	3.73	3.60	3.21	3.01	2.75	2.56	2.29	2.10	1.83	1.44	1.44	0.92	0.72	0.39	0.07	0.00	0.00	0.00
Core 90-4(Bottom part) 130-132 cm	1.26	1.17	1.08	0.99	0.90	0.84	0.75	0.68	0.56	0.45	0.45	0.29	0.25	0.18	0.11	0.09	0.07	0.16
Core 90-8A 80-85 cm	4.77	4.48	4.18	3.78	3.58	3.38	3.08	2.78	2.39	1.89	1.89	1.29	1.09	0.80	0.50	0.50	0.30	1.09
Core 90-8B 18-20 cm	5.06	4.76	4.27	3.97	3.57	3.27	3.08	2.88	2.58	1.98	2.18	1.39	1.09	0.60	0.10	0.00	0.00	0.00
Core 90-8B 80-82 cm	5.55	5.25	4.76	4.36	4.06	3.67	3.37	3.07	2.48	1.98	1.98	1.19	1.09	0.79	0.50	0.40	0.40	1.29
Core 90-12(Bottom part) 30-32 cm	4.96	4.58	4.19	3.81	3.43	3.24	3.05	2.76	2.48	1.91	2.10	1.24	1.05	0.57	0.10	0.00	0.00	0.00
Core 90-12(Bottom part) 60-62 cm	1.45	1.40	1.27	1.14	1.00	0.93	0.79	0.71	0.58	0.48	0.48	0.32	0.29	0.21	0.13	0.13	0.08	0.16
Core 90-12(Top part) 28-30 cm	5.04	4.84	4.35	4.05	3.76	3.56	3.16	2.97	2.47	1.88	1.98	1.29	1.09	0.69	0.49	0.40	0.30	0.49
Core 90-23A 82-84 cm	4.85	4.55	4.15	3.76	3.56	3.36	3.07	2.77	2.37	1.88	1.88	1.29	0.99	0.79	0.49	0.40	0.30	0.99
Core 90-23B 10-12 cm	5.65	5.35	4.95	4.56	4.26	3.96	3.77	3.47	3.07	2.48	2.58	1.59	1.29	0.59	0.20	0.00	0.00	0.00
Core 90-38A 38-40 cm	5.13	4.83	4.34	4.04	3.75	3.45	3.16	2.96	2.47	1.87	2.07	1.28	1.18	0.79	0.49	0.49	0.30	1.18
Core 90-38A 100-102 cm	4.96	4.66	4.06	3.77	3.47	3.27	2.87	2.68	2.28	1.68	1.88	1.09	1.09	0.69	0.40	0.40	0.20	0.40
Core 90-38B 20-22 cm	5.07	4.78	4.38	3.98	3.68	3.38	3.08	2.69	2.29	1.89	1.89	1.09	1.09	0.80	0.50	0.40	0.20	0.40
Core 90-142A 37-39 cm	5.33	5.04	4.55	4.17	3.88	3.58	3.20	2.91	2.52	1.94	1.94	1.26	1.16	0.78	0.58	0.39	0.39	1.16
Core 90-142A 130-132 cm	3.59	3.15	2.71	2.45	2.10	1.84	1.58	1.40	1.14	0.88	0.96	0.61	0.61	0.44	0.26	0.26	0.18	0.61
Core 90-142B 20-22 cm	4.05	3.70	3.26	2.99	2.73	2.47	2.20	2.02	1.67	1.32	1.41	0.88	0.79	0.53	0.35	0.26	0.18	0.26
Core 90-142B 45-46 cm	2.64	2.40	2.23	1.99	1.87	1.70	1.58	1.41	1.23	0.94	1.05	0.64	0.64	0.41	0.29	0.29	0.18	0.41
Core 90-142B 47-48 cm	2.21	2.07	1.93	1.79	1.65	1.55	1.41	1.32	1.08	0.89	0.89	0.56	0.47	0.33	0.19	0.19	0.05	0.09
Core 90-146 55-56 cm	0.50	0.47	0.43	0.39	0.35	0.32	0.29	0.27	0.23	0.18	0.19	0.12	0.12	0.08	0.06	0.05	0.03	0.06
Core 90-146 100-102 cm	3.26	3.09	2.66	2.49	2.32	2.15	1.89	1.80	1.46	1.20	1.37	0.77	0.86	0.52	0.43	0.34	0.17	0.26
Core 90-151A 40-42 cm	4.16	3.96	3.66	3.47	3.17	2.97	2.77	2.58	2.18	1.78	1.88	1.19	1.09	0.89	0.50	0.50	0.30	0.50
Core 90-151A 60-65 cm	5.46	5.16	4.67	4.27	4.07	3.67	3.38	2.98	2.58	1.99	1.99	1.19	1.19	0.70	0.50	0.50	0.30	1.29
Core 90-151B 56-58 cm	3.48	3.28	2.88	2.78	2.58	2.39	2.09	1.99	1.69	1.39	1.39	0.89	0.80	0.60	0.40	0.40	0.20	0.40
Core 90-151B 80-85 cm	3.06	2.79	2.52	2.34	2.16	1.98	1.89	1.62	1.44	1.17	1.17	0.81	0.72	0.45	0.36	0.27	0.18	0.27
Core 90-178A 69-70 cm	4.53	4.26	3.83	3.48	3.13	2.87	2.61	2.35	2.00	1.57	1.57	1.04	0.96	0.70	0.44	0.35	0.26	0.70
Core 90-178B 50-52 cm	2.35	2.17	1.94	1.72	1.63	1.40	1.31	1.13	0.99	0.77	0.81	0.50	0.50	0.32	0.23	0.18	0.14	0.23
Core 90-180A 60-62 cm	4.70	4.41	3.83	3.45	3.16	2.78	2.59	2.21	1.92	1.44	1.53	0.96	0.86	0.58	0.38	0.29	0.19	0.48
Core 90-180A 108-110 cm	3.38	2.97	2.73	2.33	2.09	1.85	1.61	1.37	1.21	0.96	0.96	0.64	0.64	0.40	0.32	0.24	0.16	0.40
Core 90-180B 28-30 cm	2.46	2.24	2.01	1.79	1.57	1.45	1.29	1.12	0.95	0.78	0.78	0.50	0.50	0.34	0.22	0.22	0.11	0.17
Core 90-180B 73-75 cm	3.76	3.49	3.04	2.78	2.42	2.24	2.06	1.79	1.52	1.25	1.25	0.90	0.72	0.63	0.36	0.27	0.27	0.27
Core 90-180B 122-124 cm	7.10	6.70	6.00	5.50	5.20	4.80	4.40	4.00	3.30	2.60	2.60	1.50	1.30	0.90	0.50	0.30	0.30	0.90

Appendix 2. Predicted Sediment Chronology (Synthetic Logs)

Predicted Sediment Chronology



Location: 571885 m East
4155221 m North



Historical Bathymetry

Survey	Depth (cm)		Change
1858	-15		---
1898	-125		-110
1931	-125		0
1956	-186	(-186)	-61
1983	-123	(-120)	66
1990	-122	(-119)	1

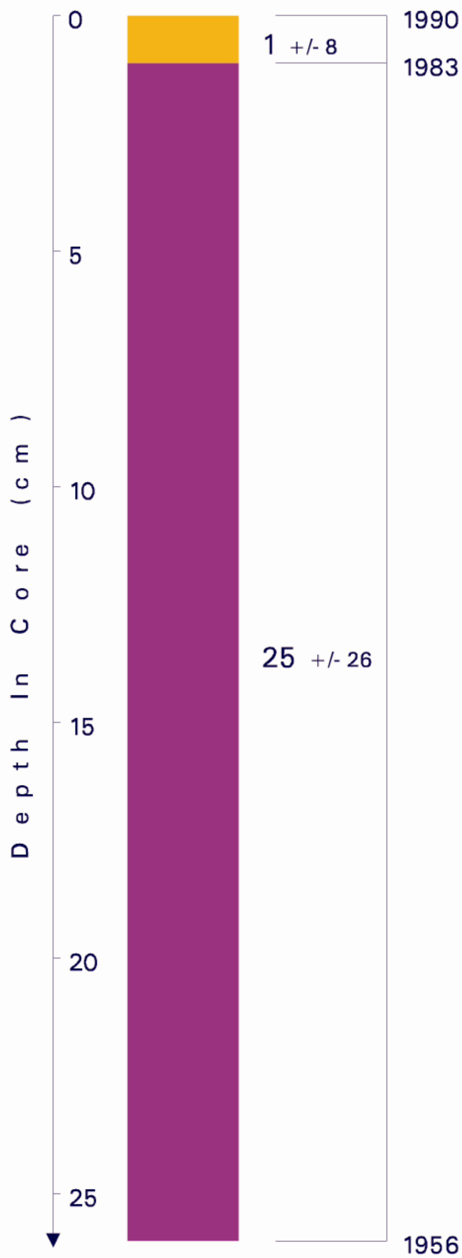
C14 depth and age in Core: 28-3 - 108 cm 2000 yrs
28-2 - 37 cm 1120 yrs

Depths referenced to MLLW for 1960 -1978 tidal epoch
( ) Depth + Cumulative Subsidence

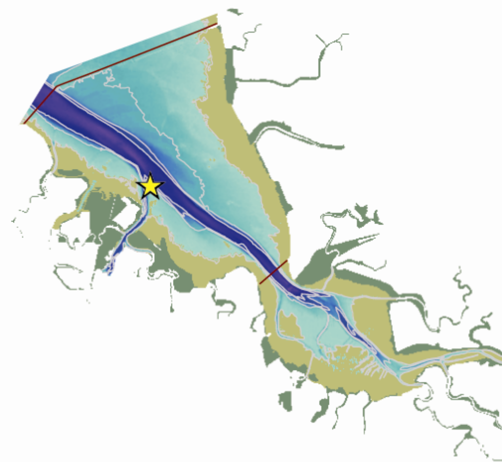
Core 90-28

Predicted Sediment Chronology

Core Reconstruction



Location: 571538 m East
4155562 m North



Historical Bathymetry

Survey	Depth (cm)		Change
1858	-103		---
1898	-171		-68
1931	-186		-15
1956	-220	(-220)	-34
1983	-195	(-198)	25
1990	-194	(-197)	1

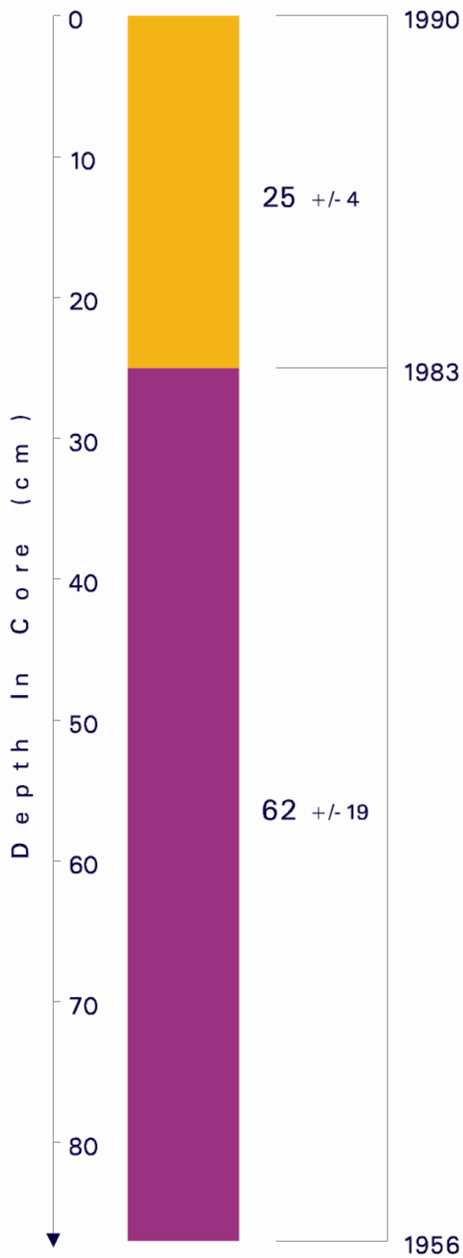
C14 depth and age in core: 93.5 cm 2060 yrs

( ) Depth + Cumulative Subsidence
Depths referenced to MLLW for 1960 -1978 tidal epoch

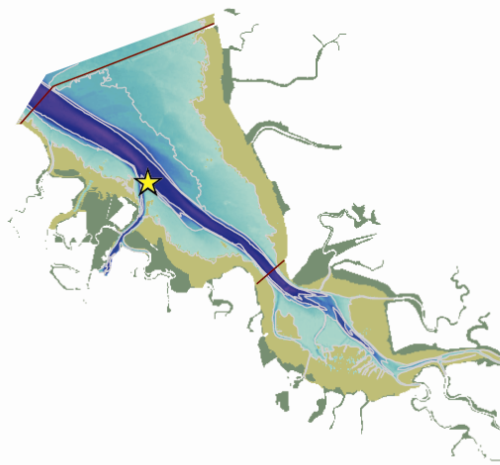
Core 90-30

Predicted Sediment Chronology

Core Reconstruction



Location: 571546 m East
4155768 m North



Historical Bathymetry

Survey	Depth (cm)		Change
1858	-272		---
1898	-639		-367
1931	-634		5
1956	-651	(-651)	-17
1983	-592	(-589)	65
1990	-567	(-564)	25

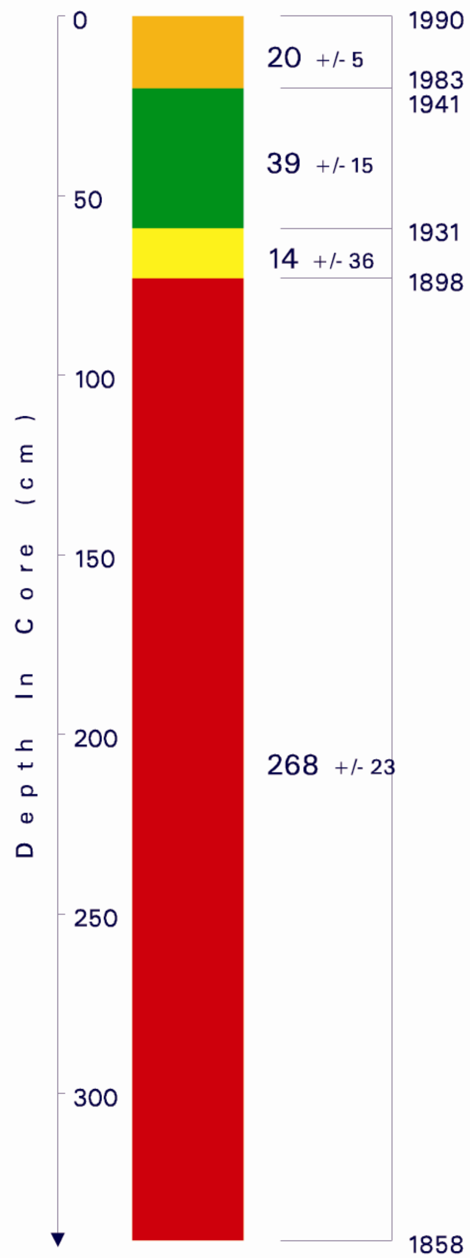
C14 depth and age in Core: 64 cm 735 yrs

( ) Depth + Cumulative Subsidence
Depths referenced to MLLW for 1960 -1978 tidal epoch

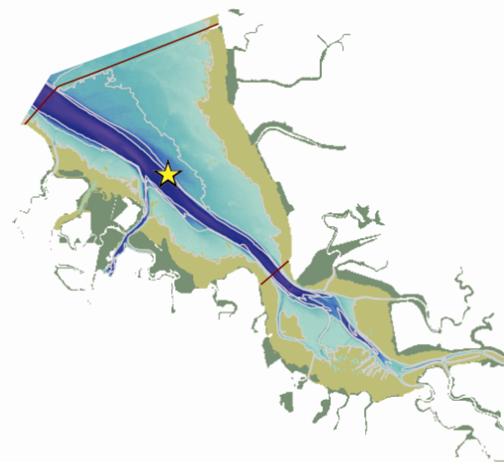
Core 90-31

Predicted Sediment Chronology

Core Reconstruction



Location: 572403 m East
4156214 m North



Historical Bathymetry

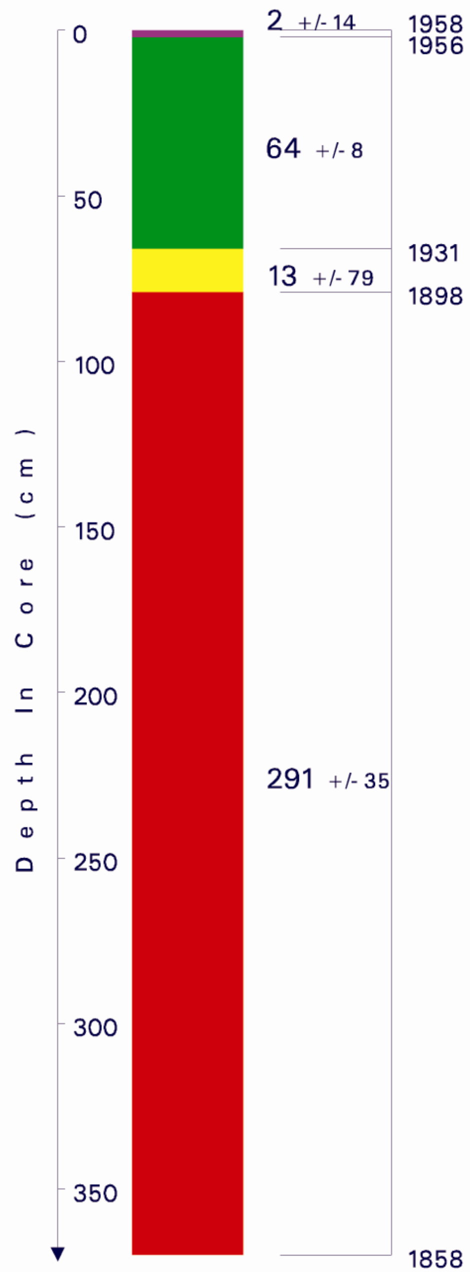
Survey	Depth (cm)		Change
1858	-1123		---
1898	-855		268
1931	-841		14
1956	-748	(-748)	93
1983	-805	(-802)	-54
1990	-785	(-782)	20

C14 depth in core: 117.5 cm 1920 yrs
and 106 cm 1650 yrs

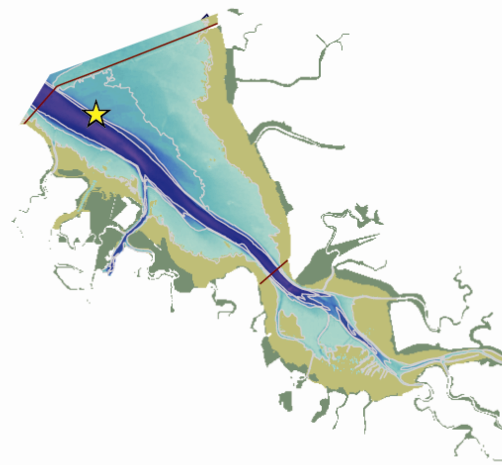
( ) Depth + Cumulative Subsidence
Depths referenced to MLLW for 1960 -1978 tidal epoch

Core 90-36

Predicted Sediment Chronology



Location: 568771 m East
4159197 m North



Historical Bathymetry

Survey	Depth (cm)	Change
1858	-1076	---
1898	-785	291
1931	-772	13
1956	-708	64
1983	-676	32
1990	-706	-30

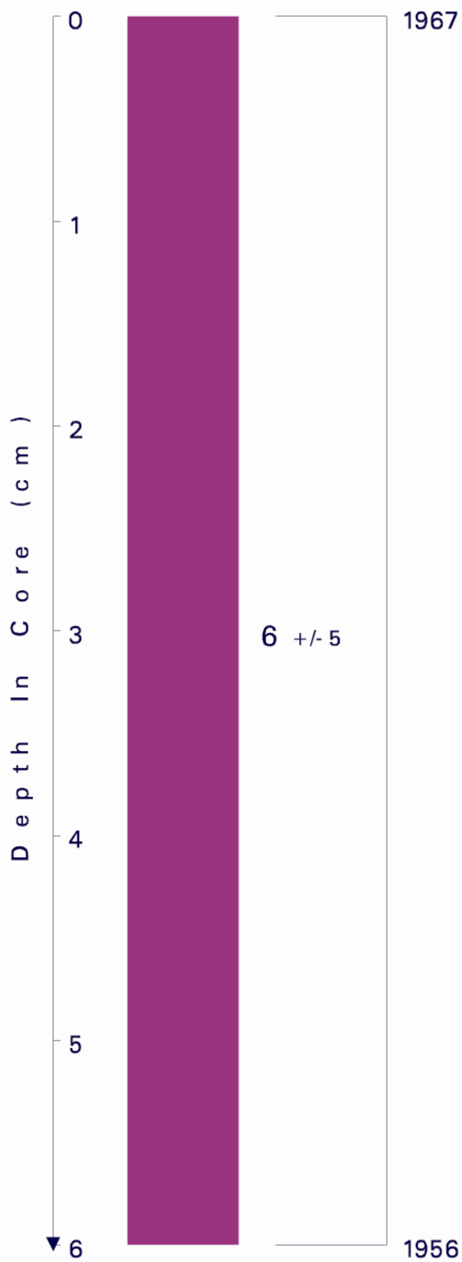
C14 depth and age in core: 85 cm 1290 yrs

Depths referenced to MLLW for 1960 -1978 tidal epoch

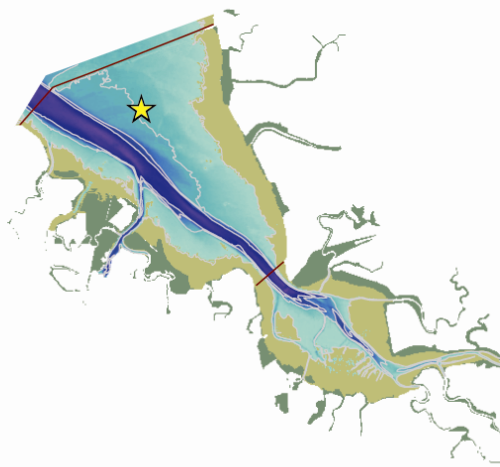
Core 90-150

Predicted Sediment Chronology

Core Reconstruction



Location: 571271 m East
4159520 m North



Historical Bathymetry

Survey	Depth (cm)	Change
1858	-71	---
1898	-45	26
1931	-93	-48
1956	-185	-92
1983	-170	15
1990	-179	-9

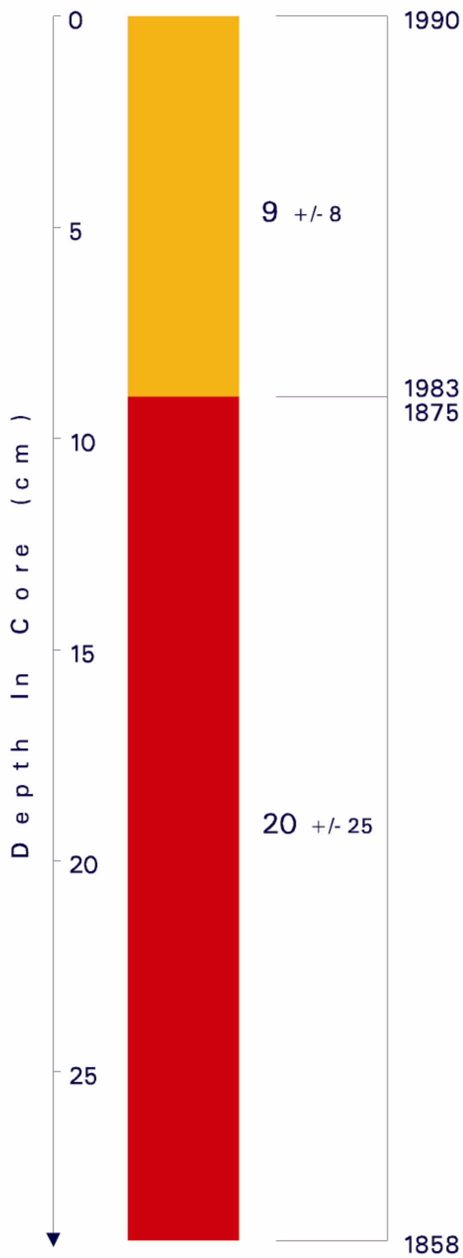
C14 depth and age in core: 145 cm 3580 yrs

Depths referenced to MLLW for 1960 -1978 tidal epoch

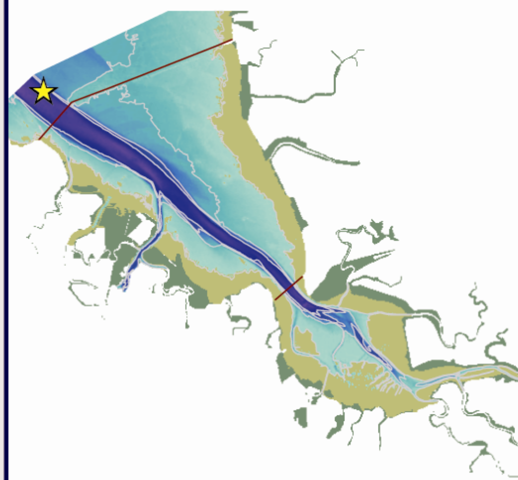
Core 90-151

Predicted Sediment Chronology

Core Reconstruction



Location: 565307 m East
4161194 m North



Historical Bathymetry

Survey	Depth (cm)	Change
1858	-1415	---
1898	-1368	47
1931	-1354	14
1956	-1374	-20
1983	-1395	-21
1990	-1386	9

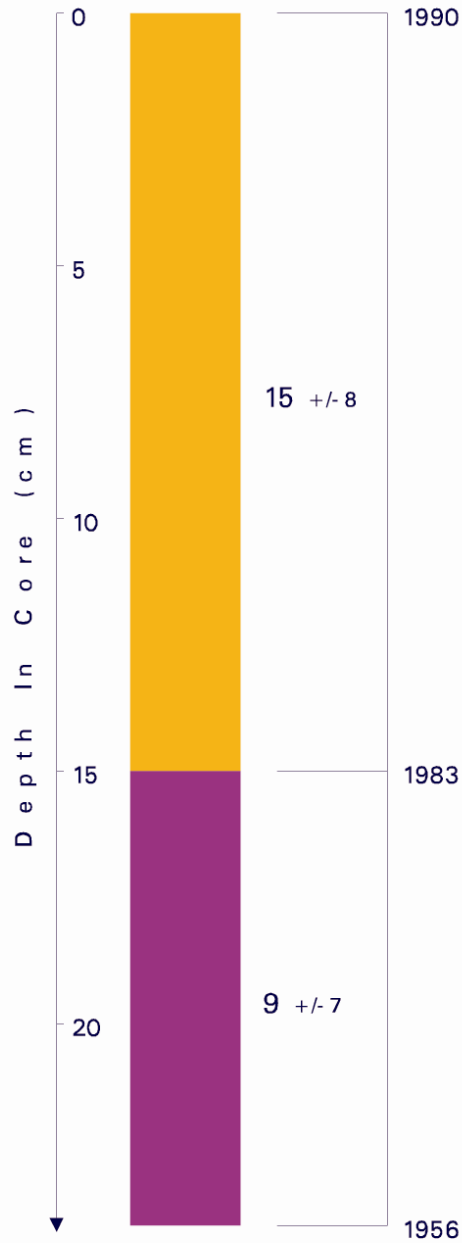
C14 depth and age in core: 84 cm 1140 yrs

Depths referenced to MLLW for 1960 -1978 tidal epoch

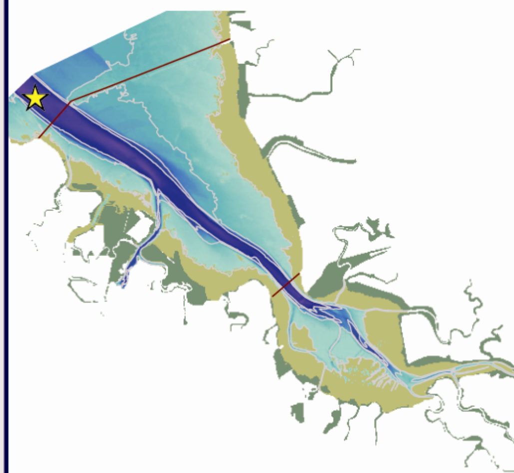
Core 90-177

Predicted Sediment Chronology

Core Reconstruction



Location: 564941 m East
4160829 m North



Historical Bathymetry

Survey	Depth (cm)	Change
1858	-1454	---
1898	-1410	44
1931	-1472	-62
1956	-1519	-47
1983	-1510	9
1990	-1495	15

C14 depth and age in core: 100 cm 7280 yrs

Depths referenced to MLLW for 1960 -1978 tidal epoch

Core 90-178

Appendix 3. Annotated Lithologic Logs

Software developed by Brian Edwards and Daniel Ponti at the U.S. Geological Survey in Menlo Park was used to make the 51 graphic logs displayed here. Handwritten logs and X-radiographs from which the graphic logs are derived may be viewed at *http://walrus.wr.usgs.gov/infobank/j/j190sf/html/j-1-90-sf.meta.html* and *http://walrus.wr.usgs.gov/infobank/j/j290sf/html/j-2-90-sf.meta.html* (appendix 4). The gravity cores were collected as part of USGS Projects J-2-90-SF and J-1-91-SF (Anima and others, 2005).

Symbols used in the graphic logs are illustrated in table 3. Remarks on the logs explain specific features of the cores. Colors reported in logs created solely from X-radiographs are estimated based on experience with x radiographs and visual logs of cores taken nearby

Table A1. Symbols used in the graphic logs.

PHYSICAL STRUCTURES		
Current Ripples	High Angle Tabular Bedding	Assymmetric ripples
LITHOLOGIC ACCESSORIES		
Pebbles/Granules	Shell Fragments	
ICHNOFOSSILS		
Burrows, undifferentiated		
FOSSILS		
Molluscs (undifferentiated)	Gastropods	Plant Remains, undiff.

U.S. GEOLOGICAL SURVEY

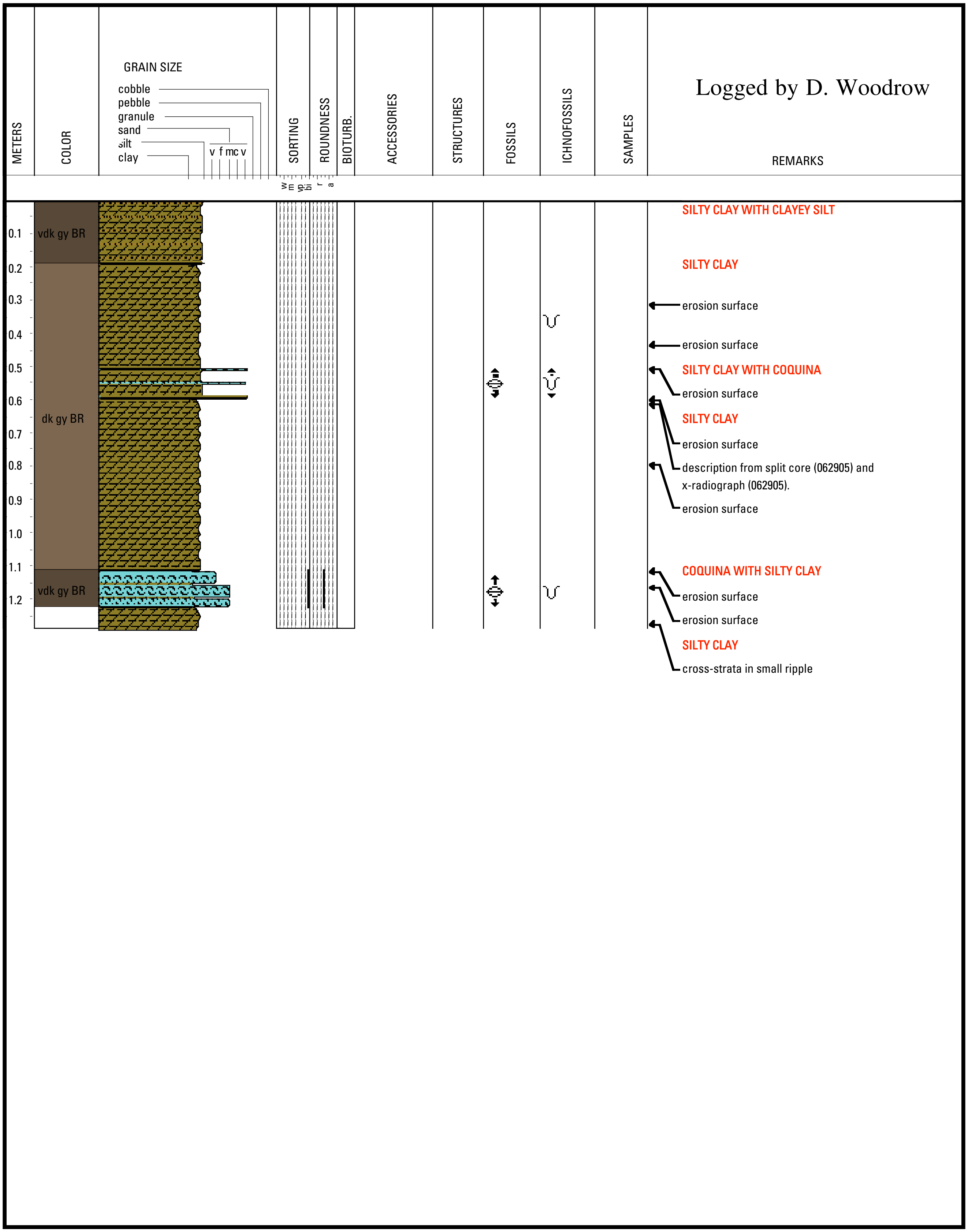
Collected: 1/23/1990

Cruise: J-2-90-SF

Water Depth: 14 feet

Site: 90-1

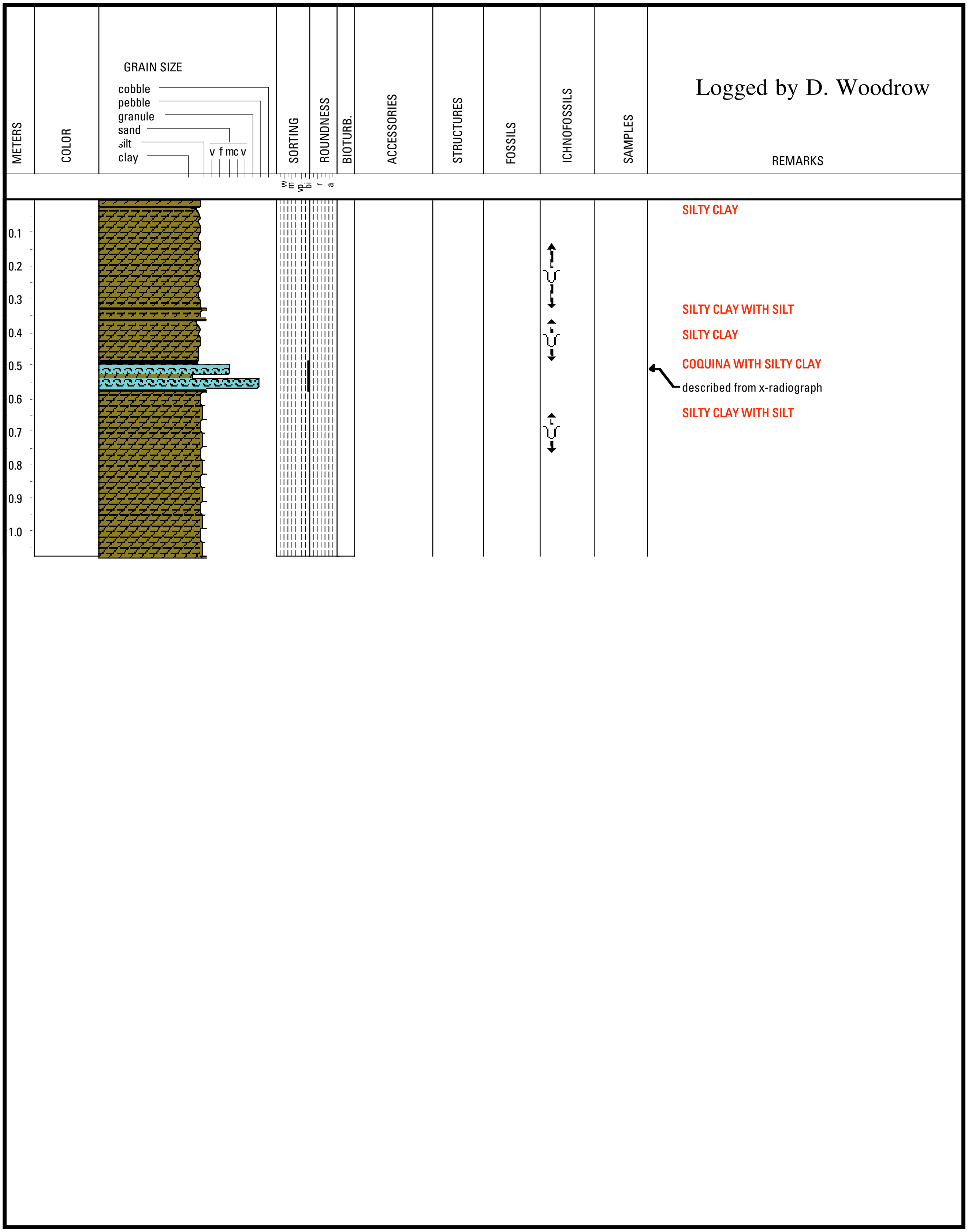
lat 37° 27' 23.4" N., long 122° 2' 29.9" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-2

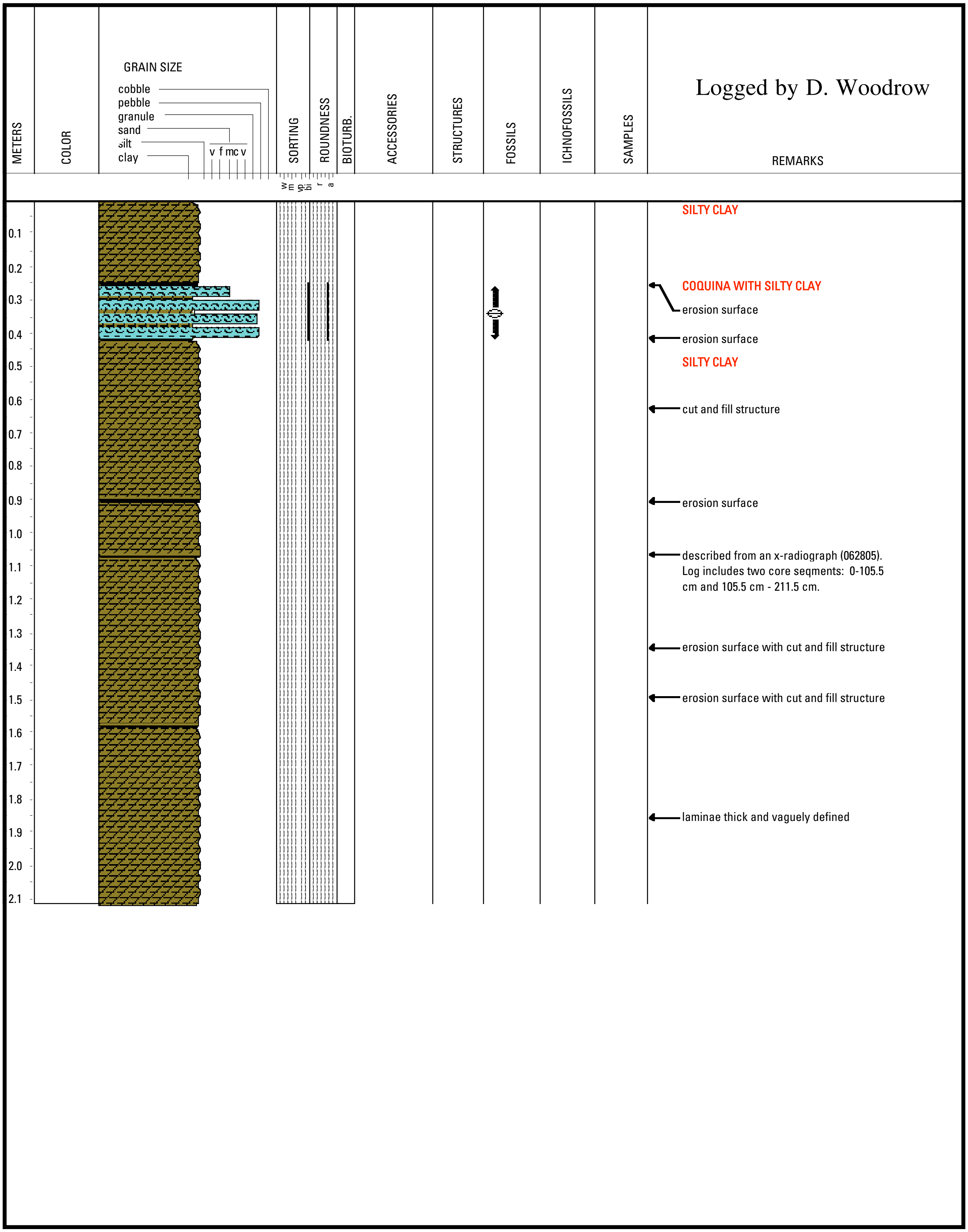
Collected: 1/1/1990
Water Depth: 2 meters
lat 37° 27' 23.4" N., long 122° 2' 29.9" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-3

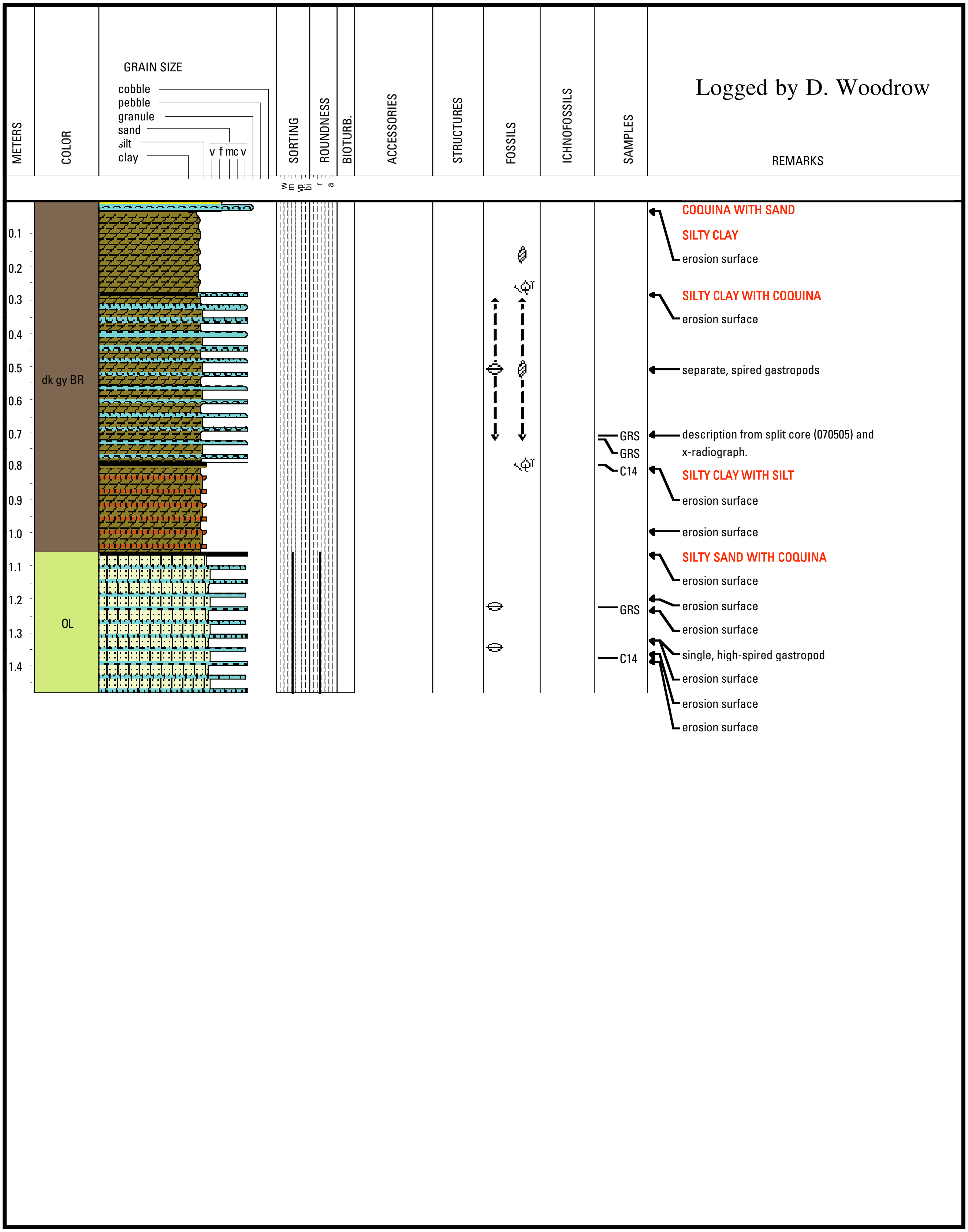
Collected: 1/23/2005
Water Depth: 2 meters
lat 37° 27' 25.2" N., long 122° 2' 24.5" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-4

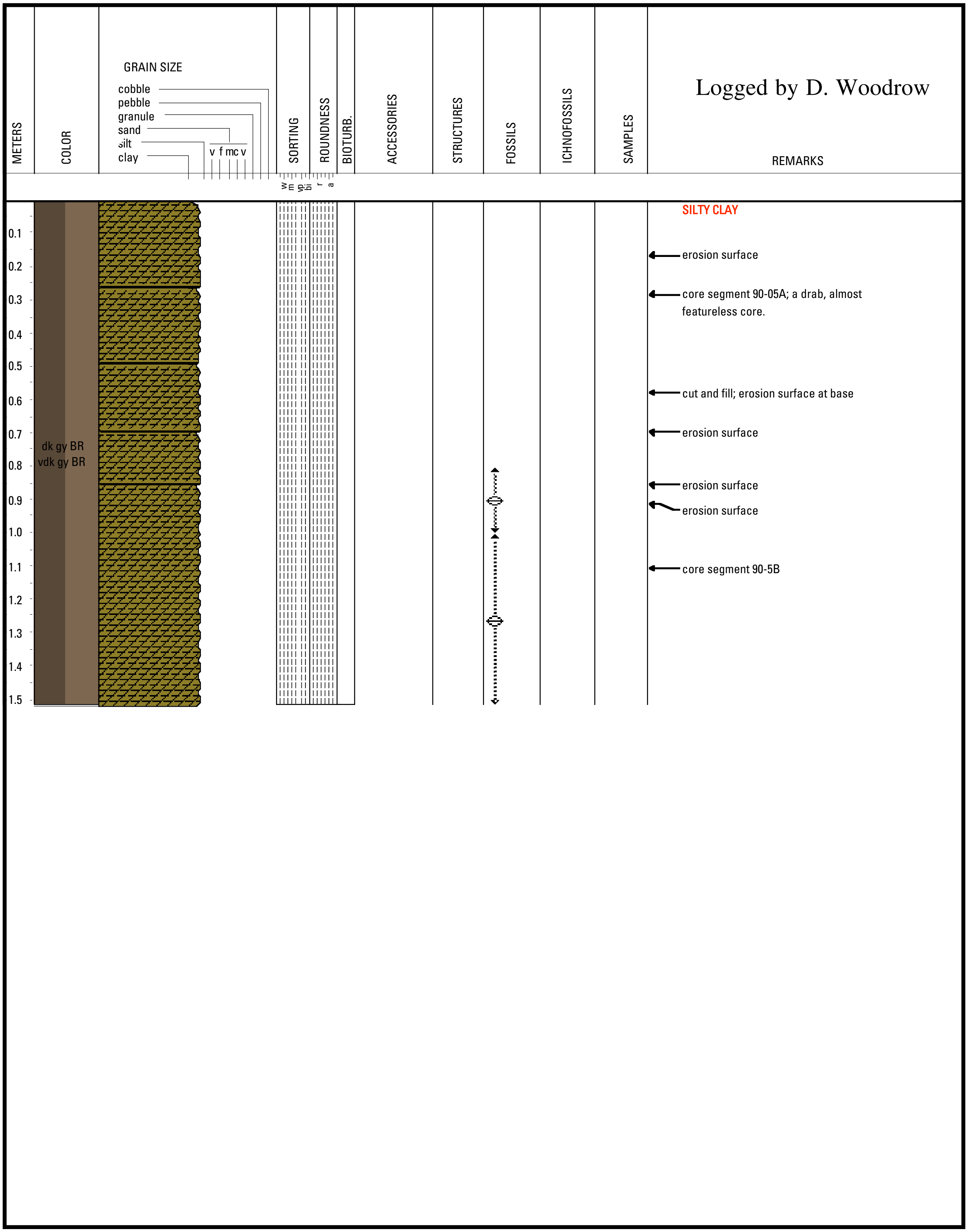
Collected: 1/23/1990
Water Depth: 3 meters
lat 37° 27' 20.5" N., long 122° 3' 6.1" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-5

Collected: 1/23/1990
Water Depth: 3 meters
lat 37° 28' 3.6" N., long 122° 3' 12.2" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

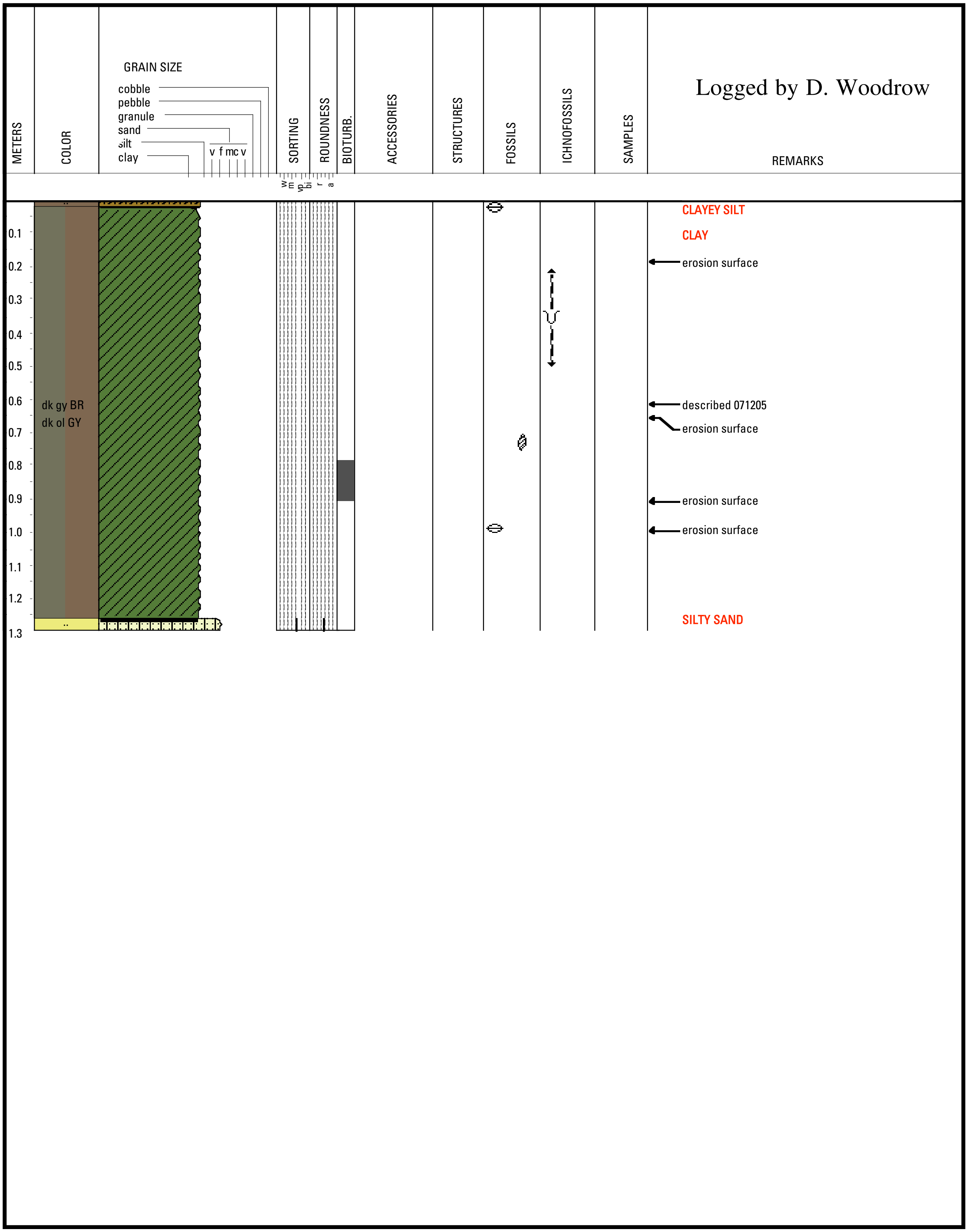
Collected: 1/1/1990

Cruise: J-2-90-SF

Water Depth: 25 feet

Site: 90-6

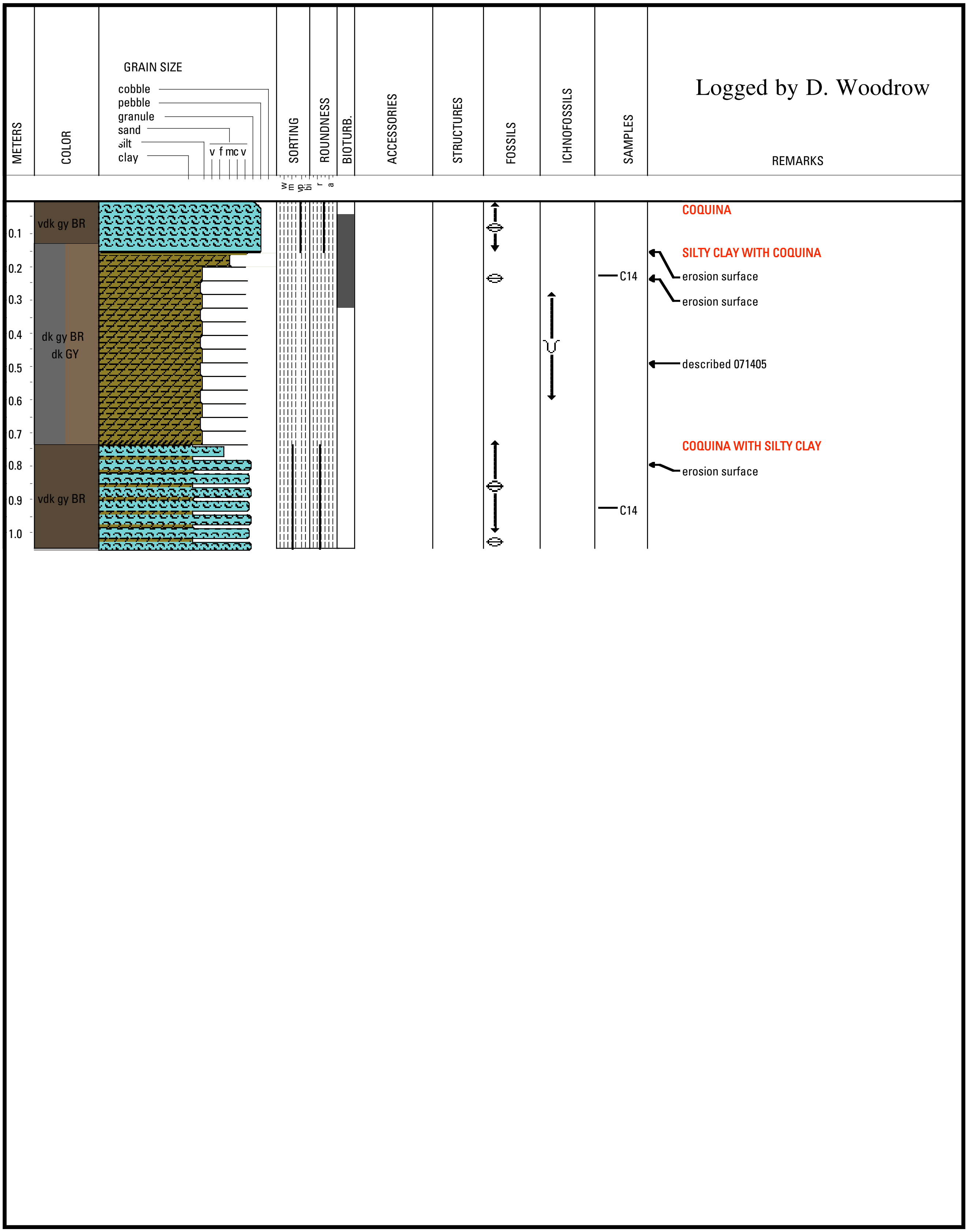
lat 37° 28' 33.1" N., long 122° 4' 20.9" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-7

Collected: 1/1/1990
Water Depth: 5 meters
lat 37° 29' 8.3" N., long 122° 4' 32" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

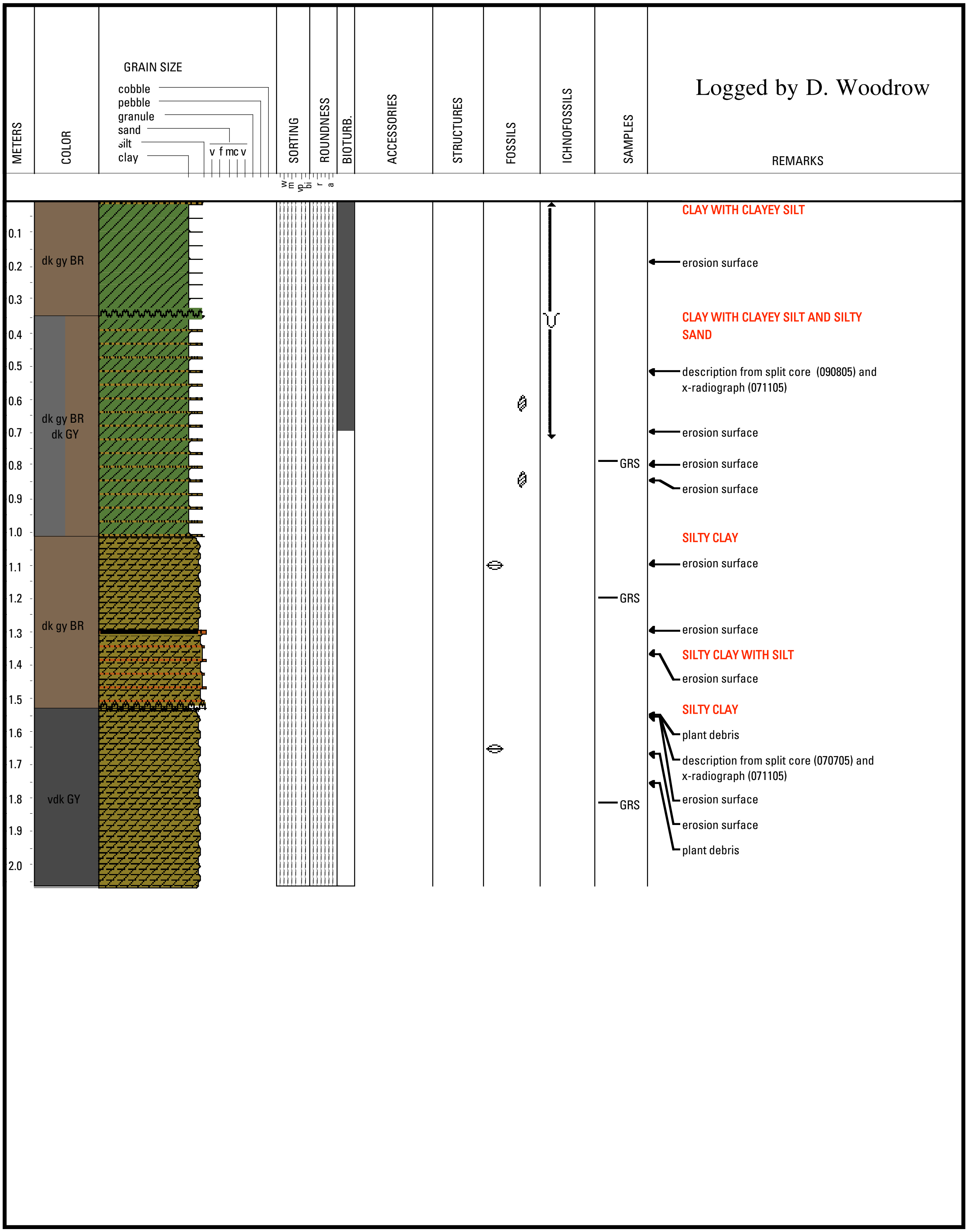
Collected: 1/1/1990

Cruise: J-2-90-SF

Water Depth: 4 meters

Site: 90-8

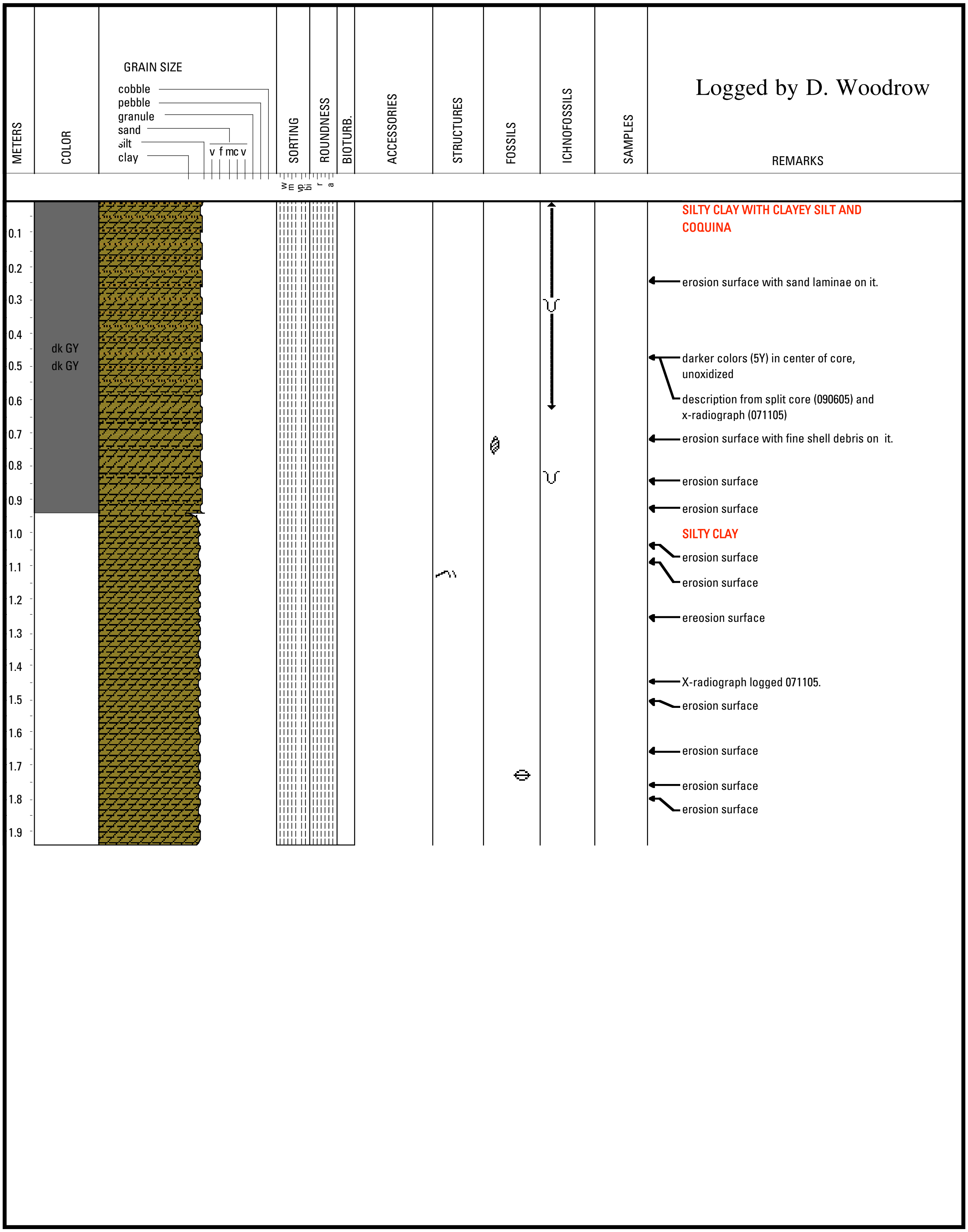
lat 37° 29' 20.5" N., long 122° 4' 25.9" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-9

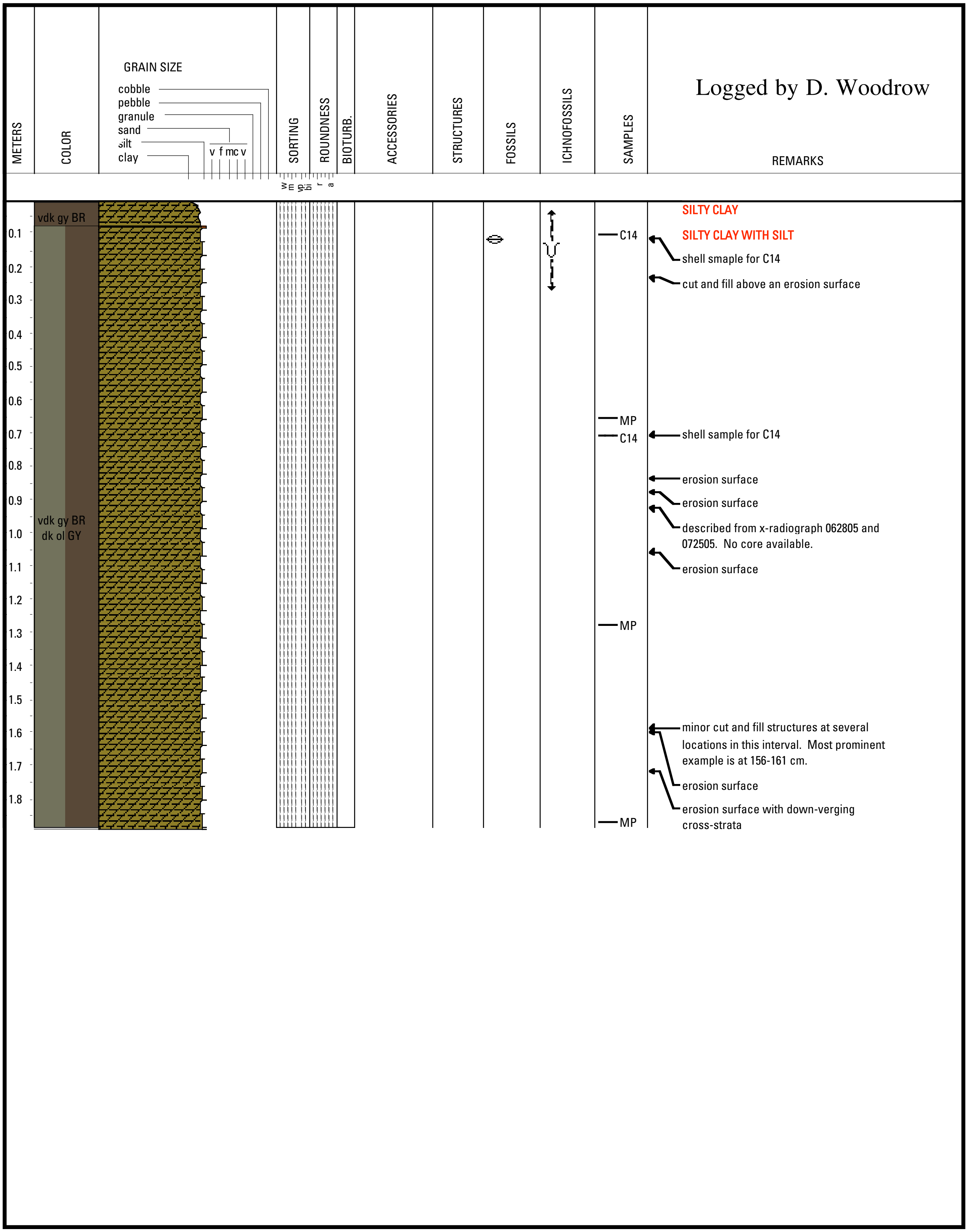
Collected: 1/24/1990
Water Depth: 6 meters
lat 37° 29' 20.5" N., long 122° 5' .7" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-10

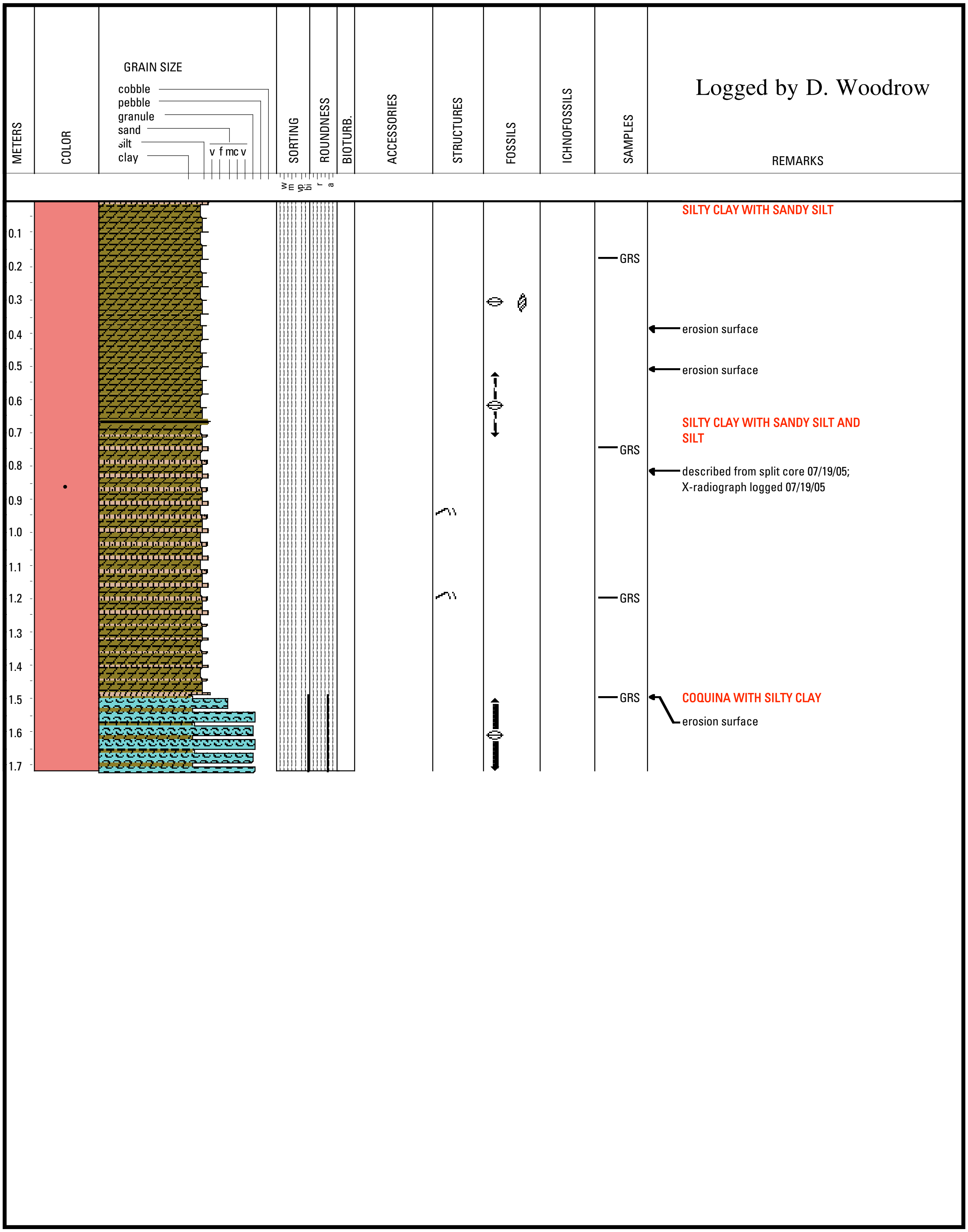
Collected: 1/1/1990
Water Depth: 6 meters
lat 38° 29' 19.8" N., long 122° 5' 12.6" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-12

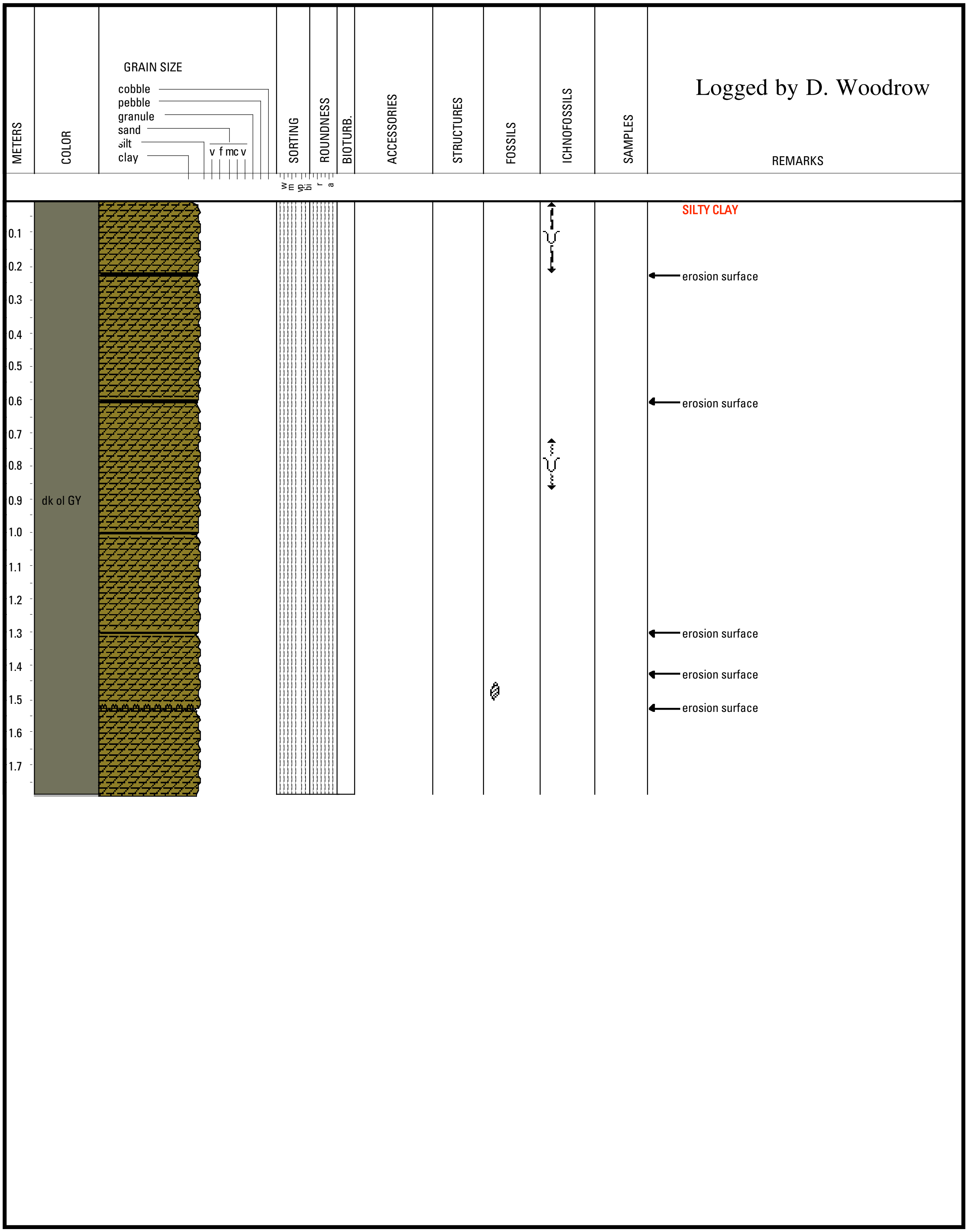
Collected: 1/1/1990
Water Depth: 8 meters
lat 37° 29' 17.6" N., long 122° 6' 3.2" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-13

Collected: 1/1/1990
Water Depth: 5 meters
lat 37° 29' 26.6" N., long 122° 5' 35.6" W. (WGS84 datum)

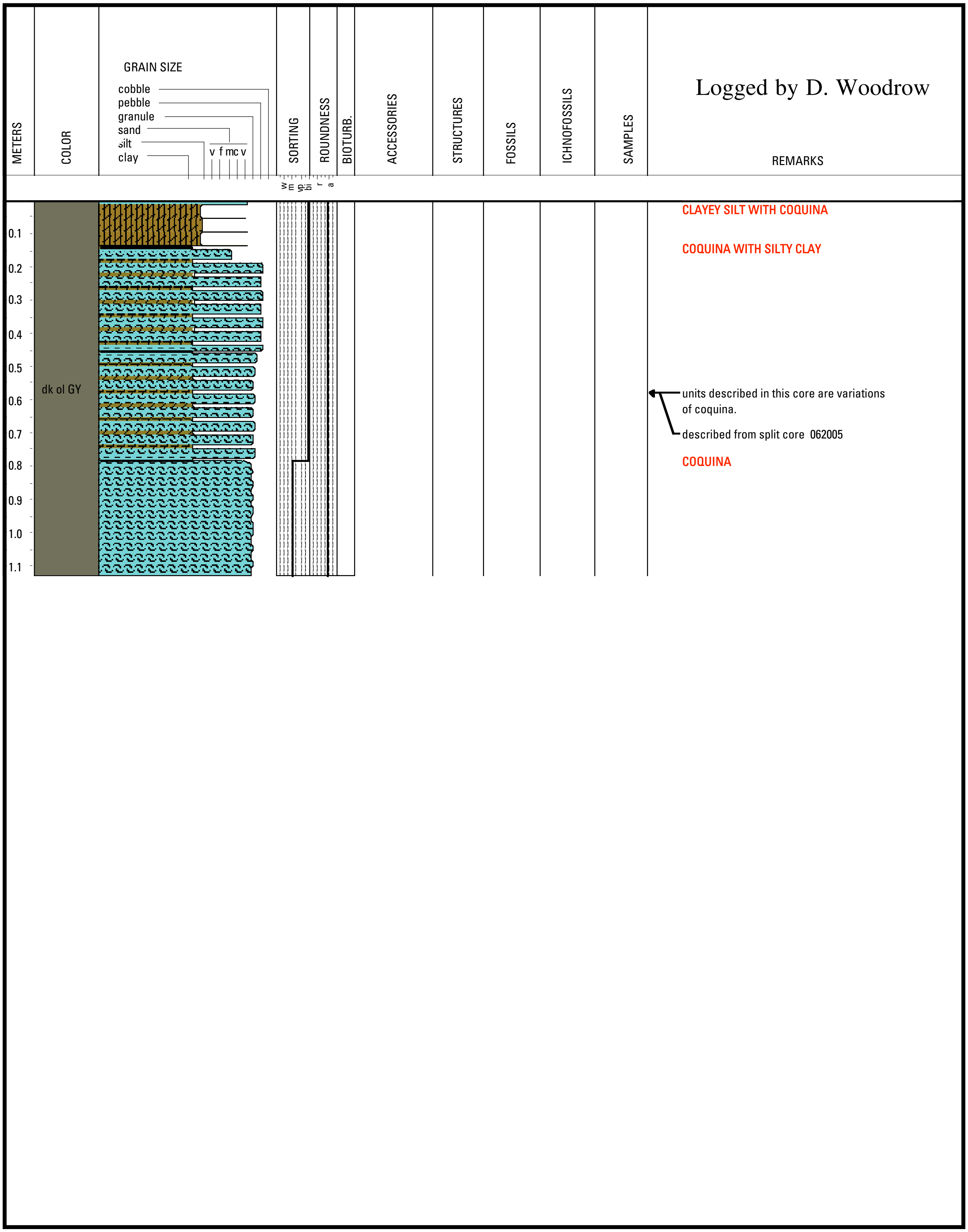


U.S. GEOLOGICAL SURVEY

Collected: 1/1/1990

Cruise: J-2-90-SF
Water Depth: 36 feet

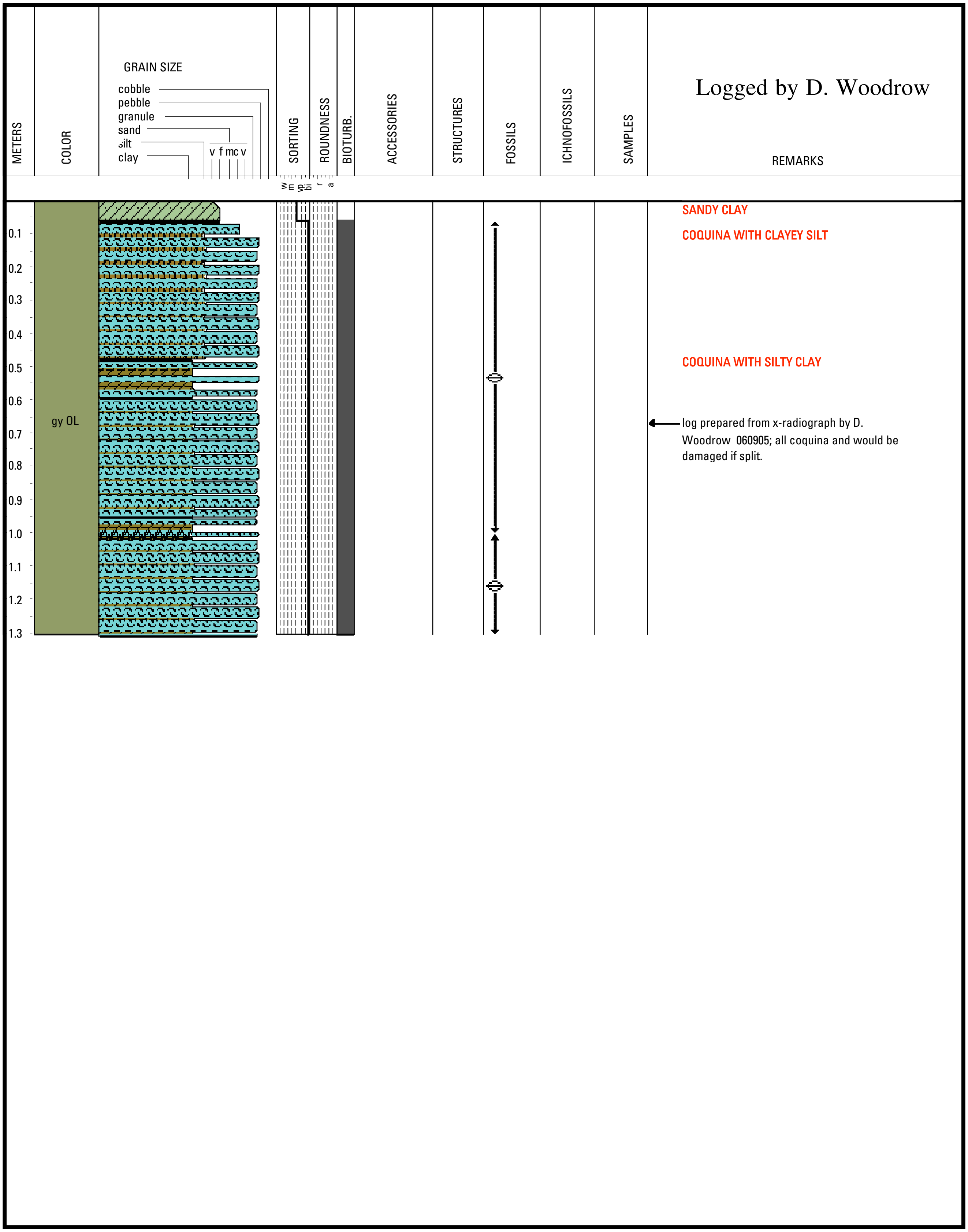
Site: 90-19
lat 37° 31' 7.9" N., long 122° 8' 18.4" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-20

Collected: 1/1/1990
Water Depth: 59 feet
lat 37° 31' 11.2" N., long 122° 8' 20.9" W. (WGS84 datum)

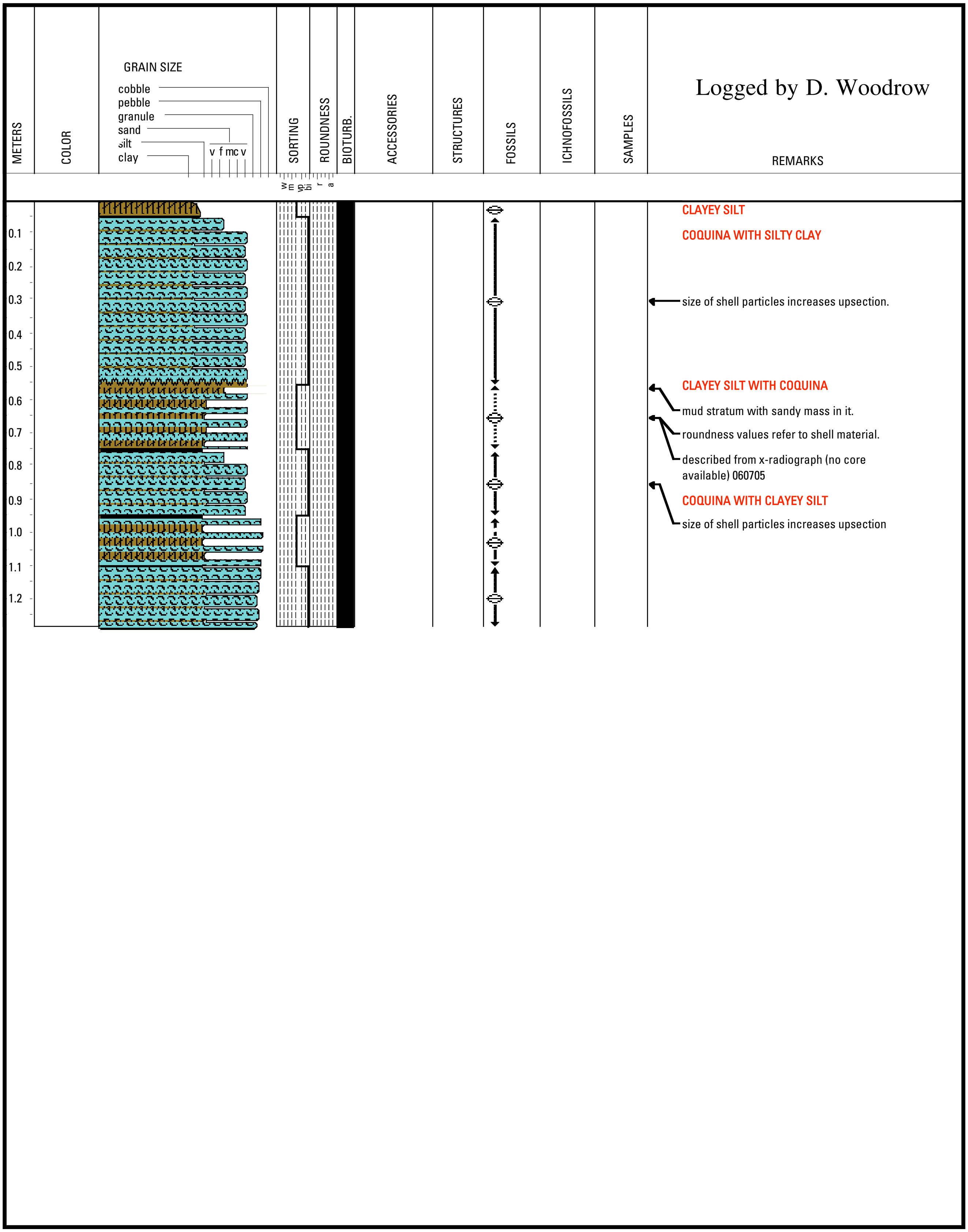


U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-21

Collected: 1/1/1990
Water Depth: 48 feet
lat 37° 31' 16.2" N., long 122° 8' 19.8" W. (WGS84 datum)

Logged by D. Woodrow



U.S. GEOLOGICAL SURVEY

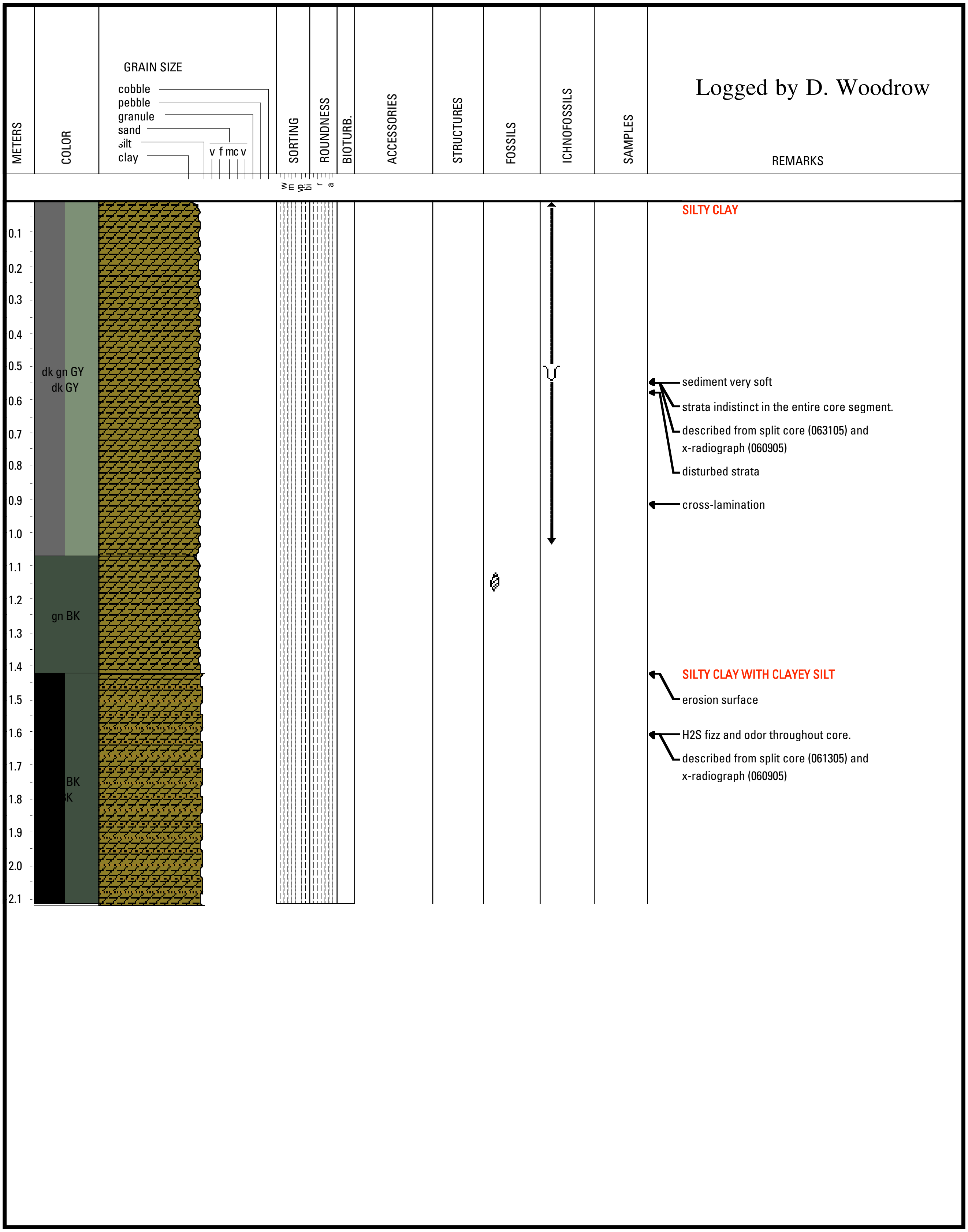
Collected: 1/1/1990

Cruise: J-2-90-SF

Water Depth: 17 feet

Site: 90-22

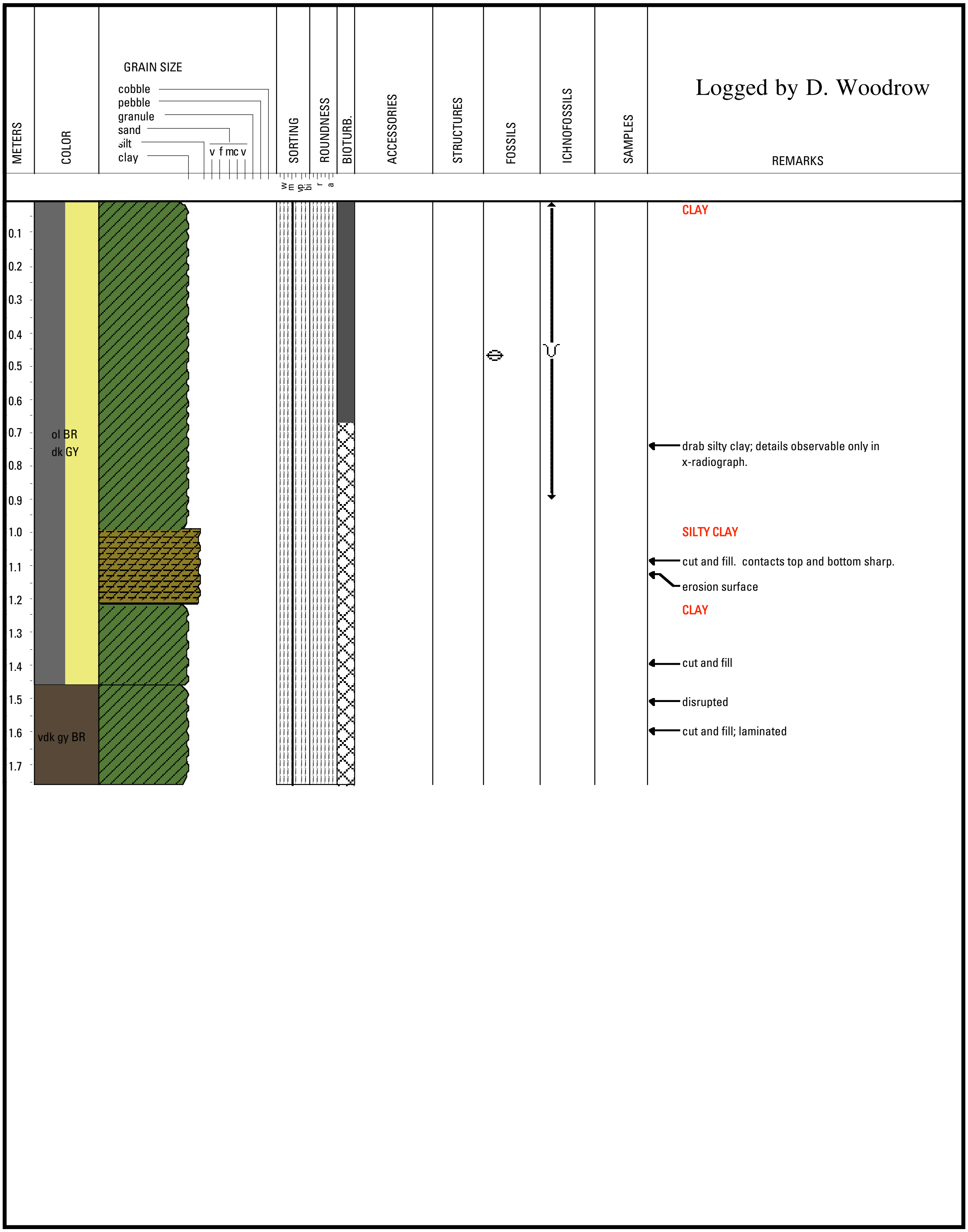
lat 37° 31' 18.7" N., long 122° 8' 18.4" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-23

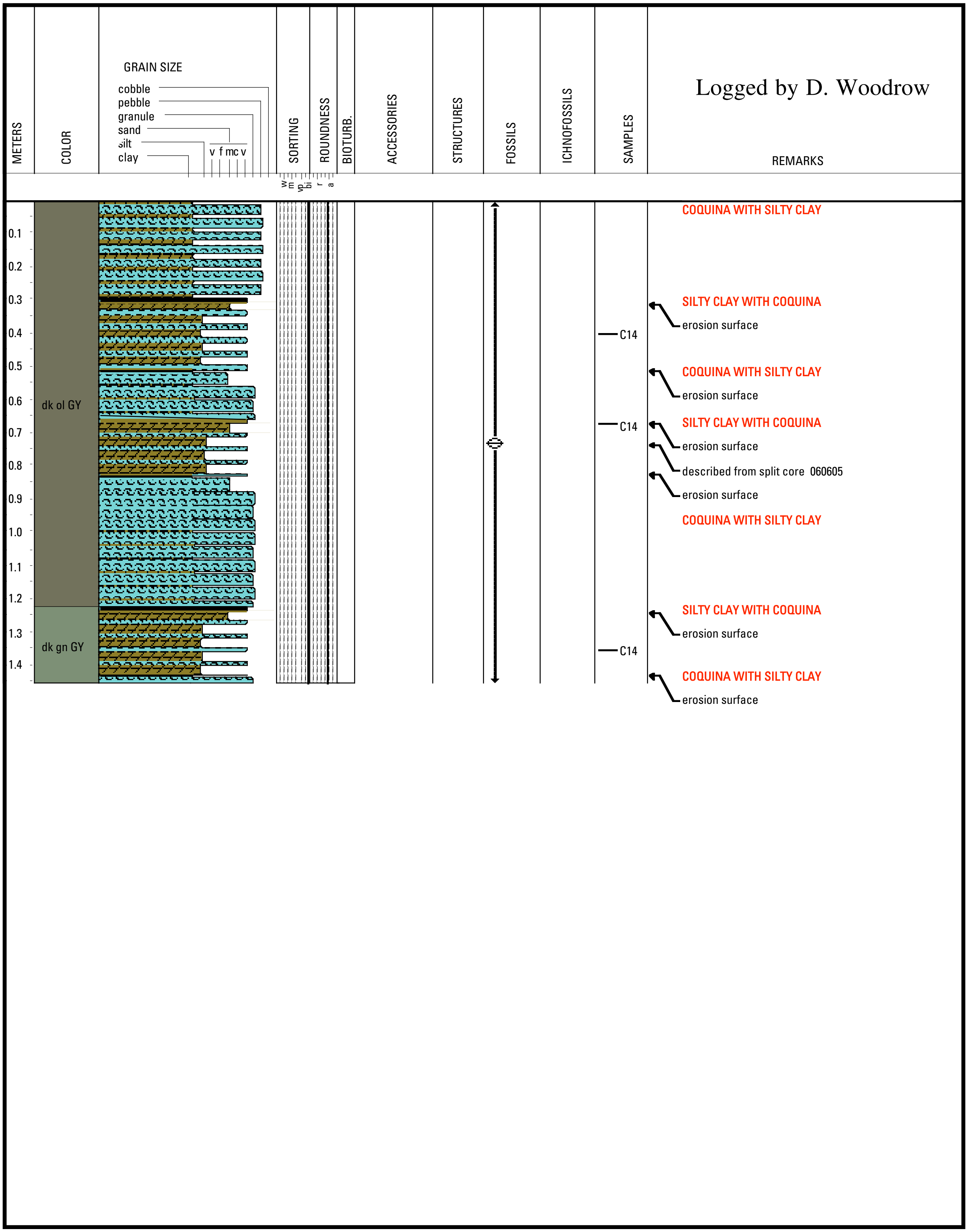
Collected: 1/1/1990
Water Depth: 24 feet
lat 37° 31' 21.2" N., long 122° 8' 15.8" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Collected: 1/1/1990
Water Depth: 20 feet

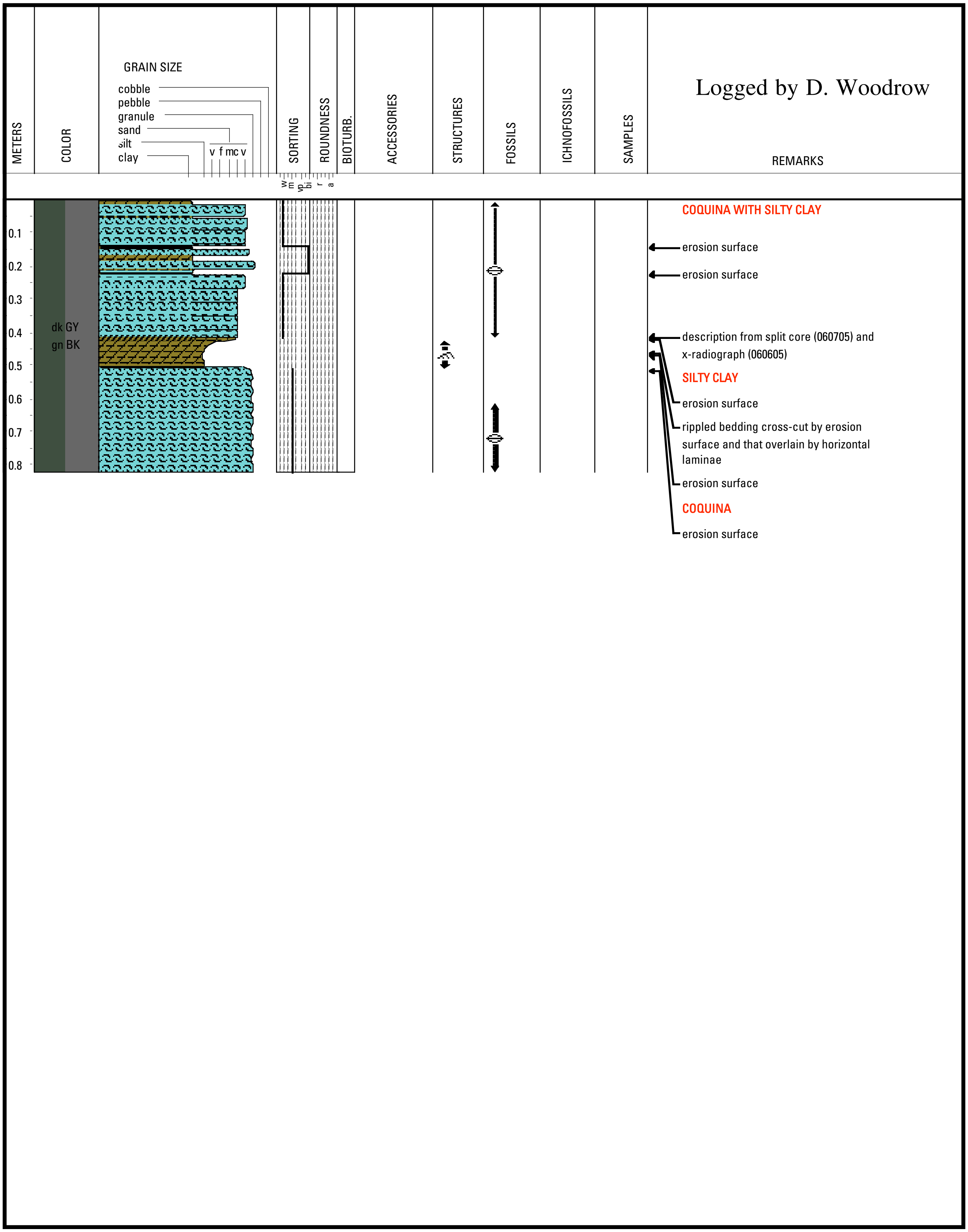
Cruise: J-2-90-SF
Site: 90-24
lat 37° 31' 29.5" N., long 122° 9' 26.6" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-25

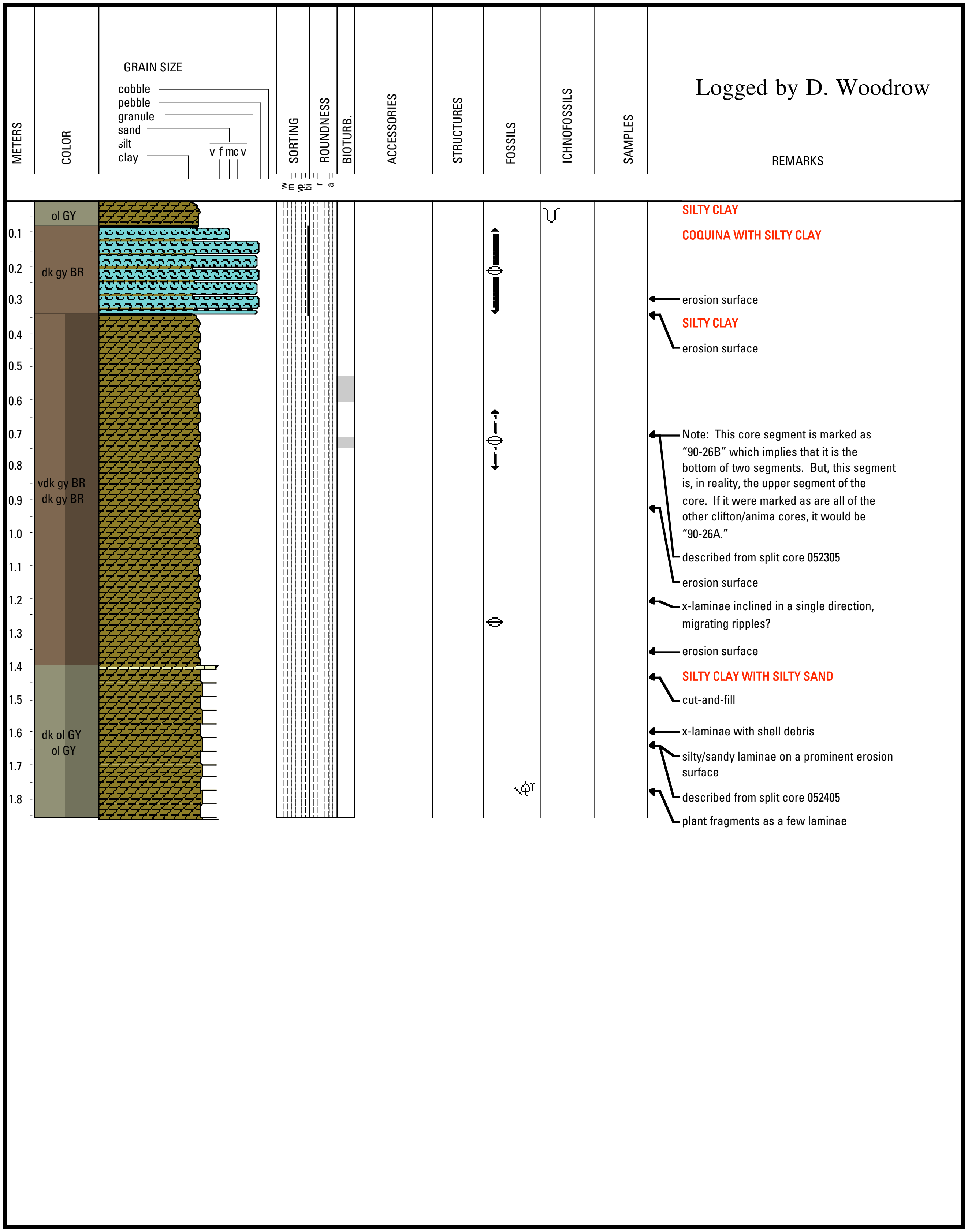
Collected: 1/1/1990
Water Depth: 15 feet
lat 37° 31' 25.9" N., long 122° 9' 32.4" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-26

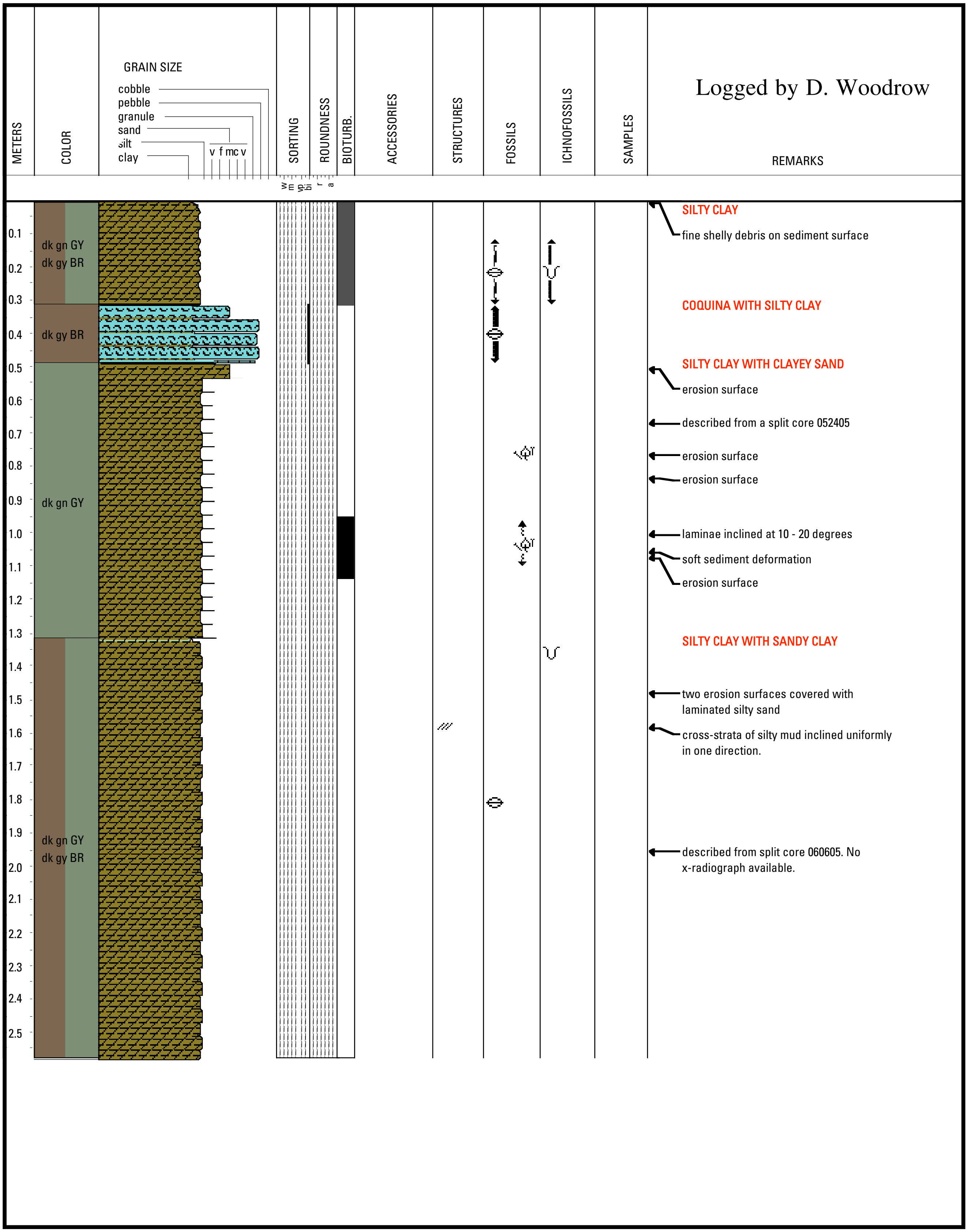
Collected: 1/25/1990
Water Depth: 20 feet
lat 37° 31' 29.9" N., long 122° 10' 2.5" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-27

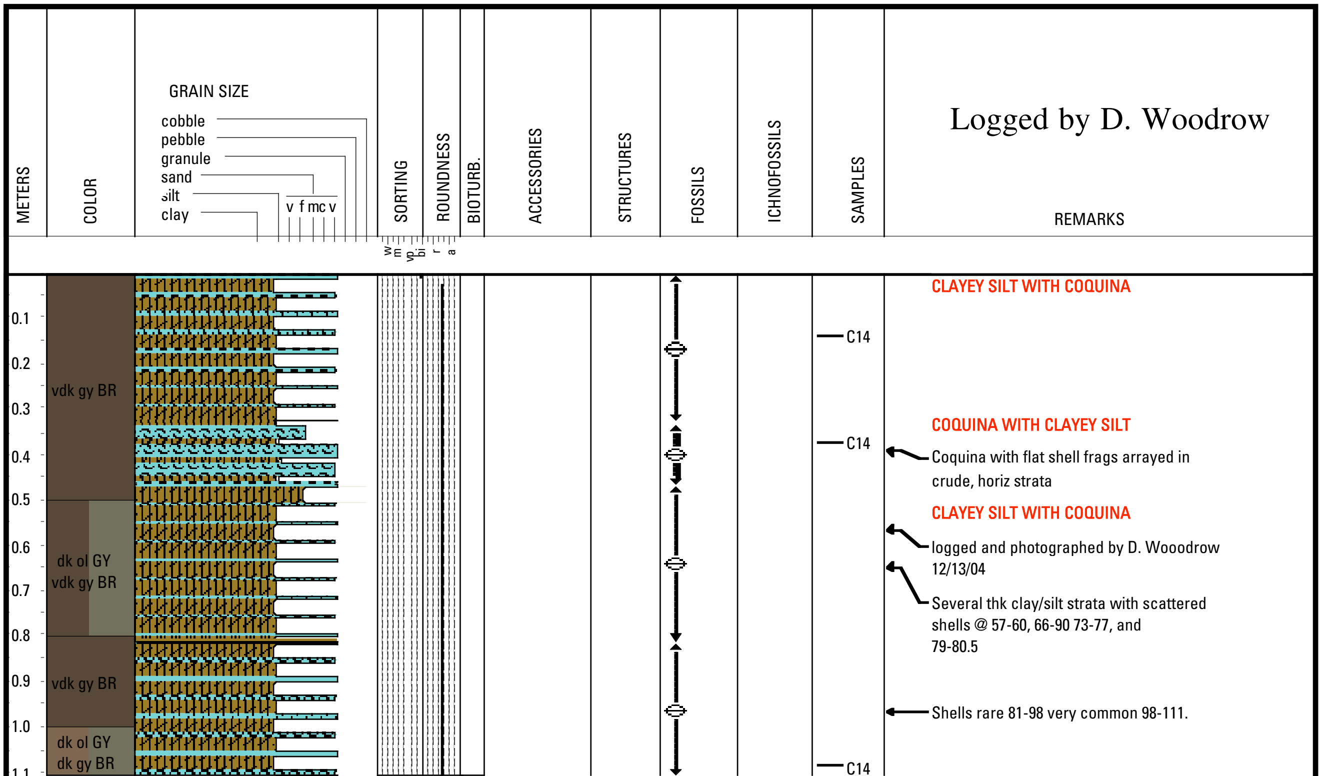
Collected: 1/25/1990
Water Depth: 25 feet
lat 37° 31' 34.6" N., long 122° 10' 7.6" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-28

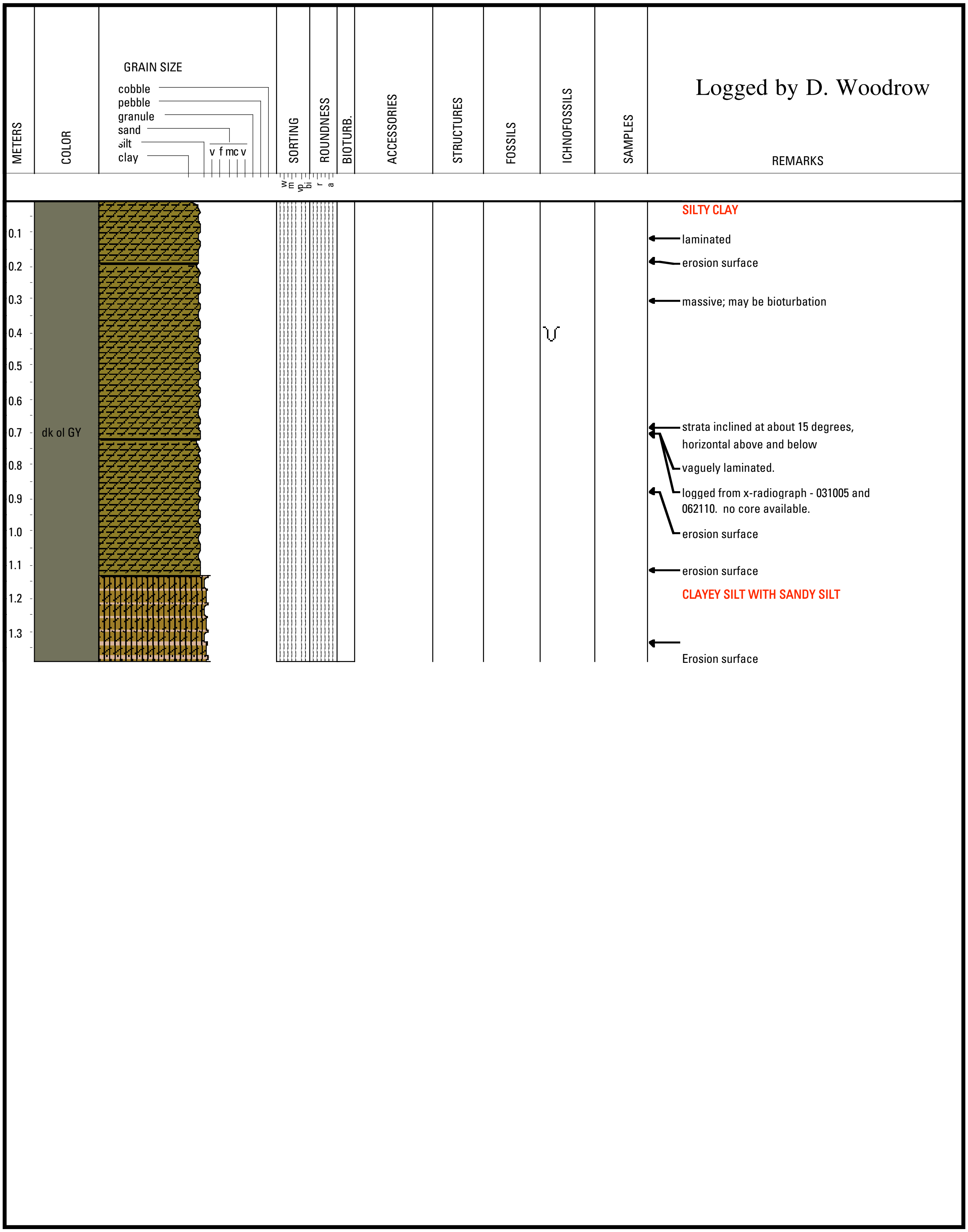
Collected: 1/1/1990
Water Depth: 3 meters
lat 37° 32' 16.9" N., long 122° 11' 6.5" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Collected: 1/1/1990
Water Depth: 20 feet

Cruise: J-2-90-SF
Site: 90-29
lat 37° 32' 24.1" N., long 122° 11' 5.4" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

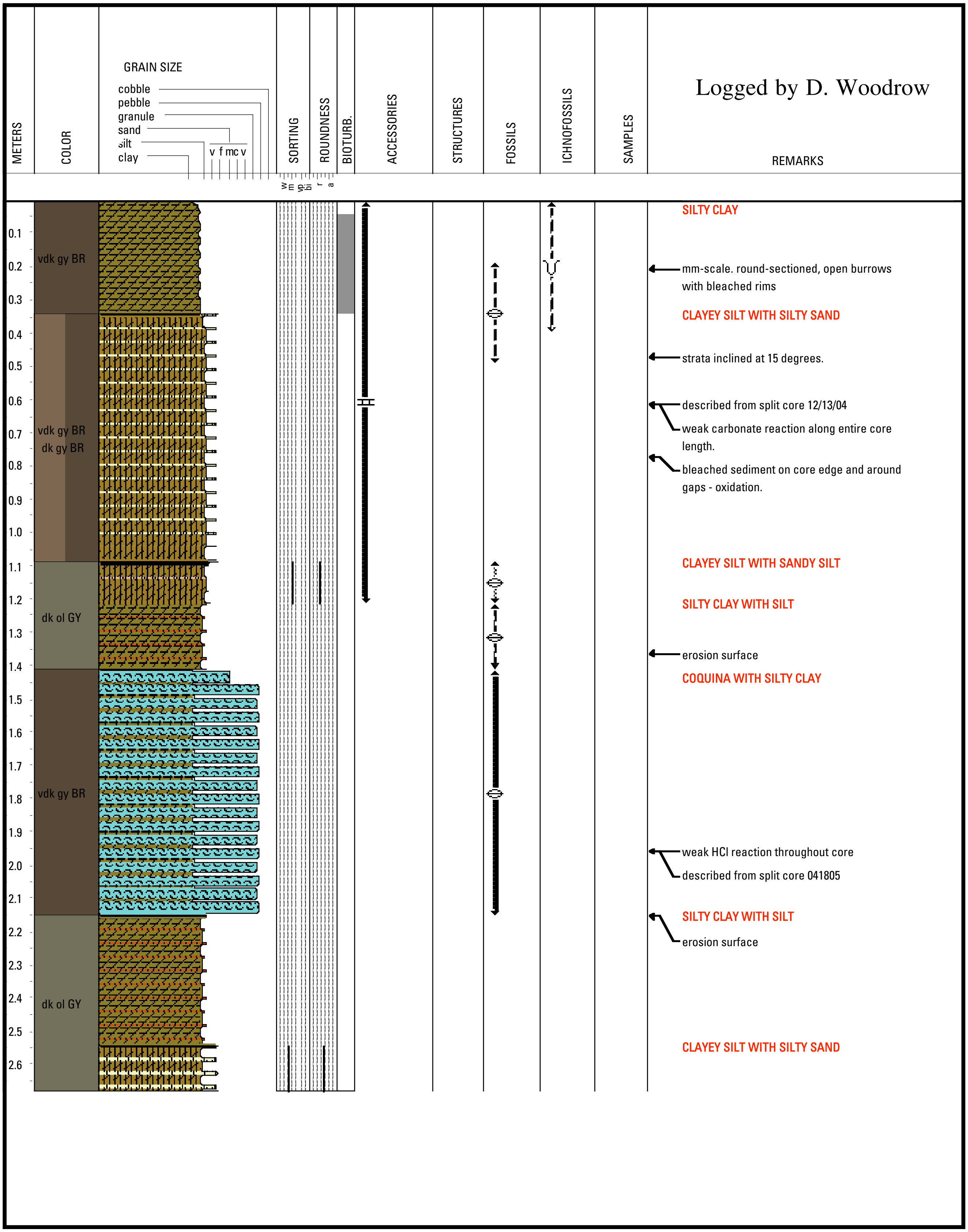
Collected: 1/1/1990

Cruise: J-2-90-SF

Water Depth: 13 feet

Site: 90-30

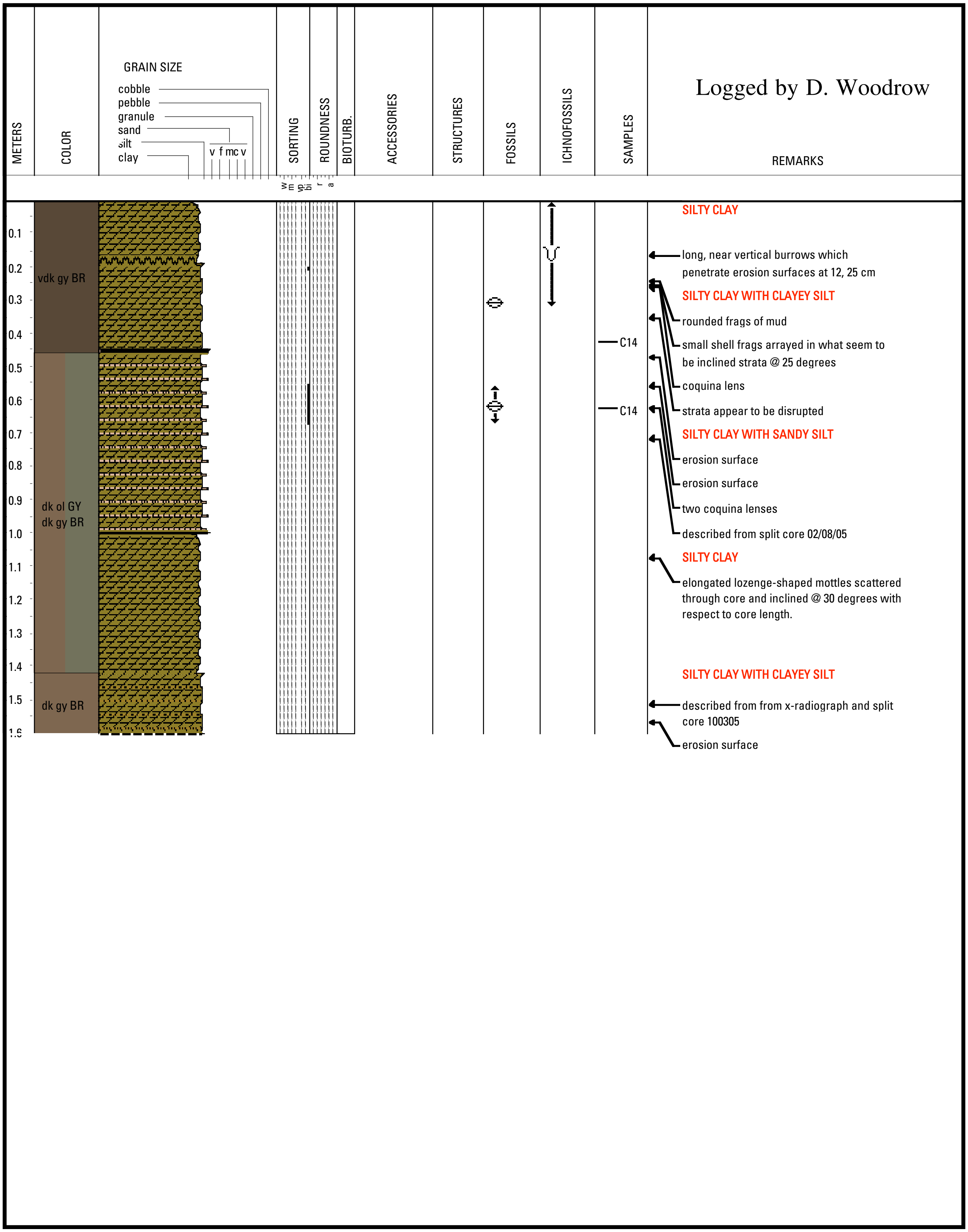
lat 37° 32' 23.8" N., long 122° 11' 14.8" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-31

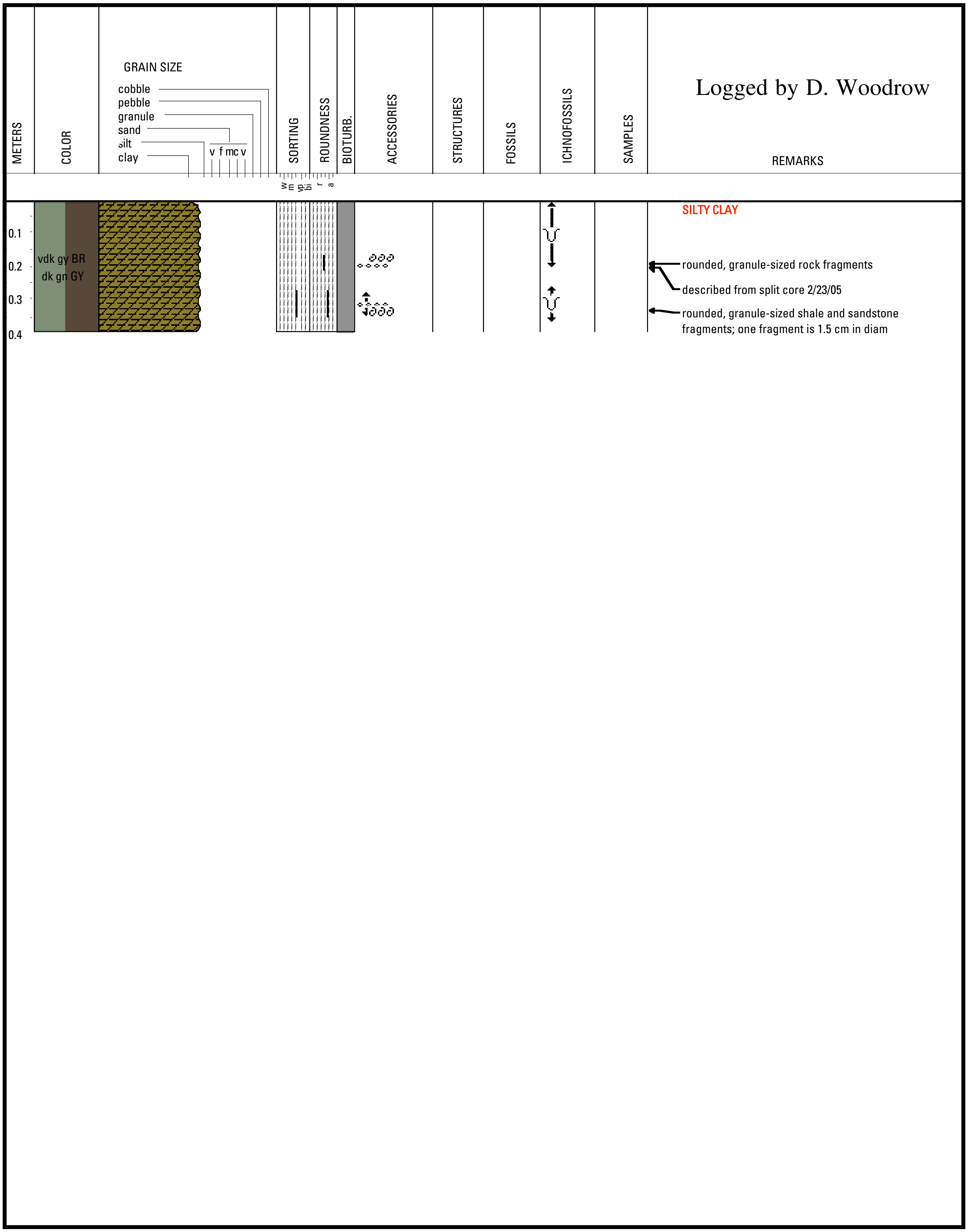
Collected: 1/1/1990
Water Depth: 11 meters
lat 37° 32' 27.7" N., long 122° 11' 14.4" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-32

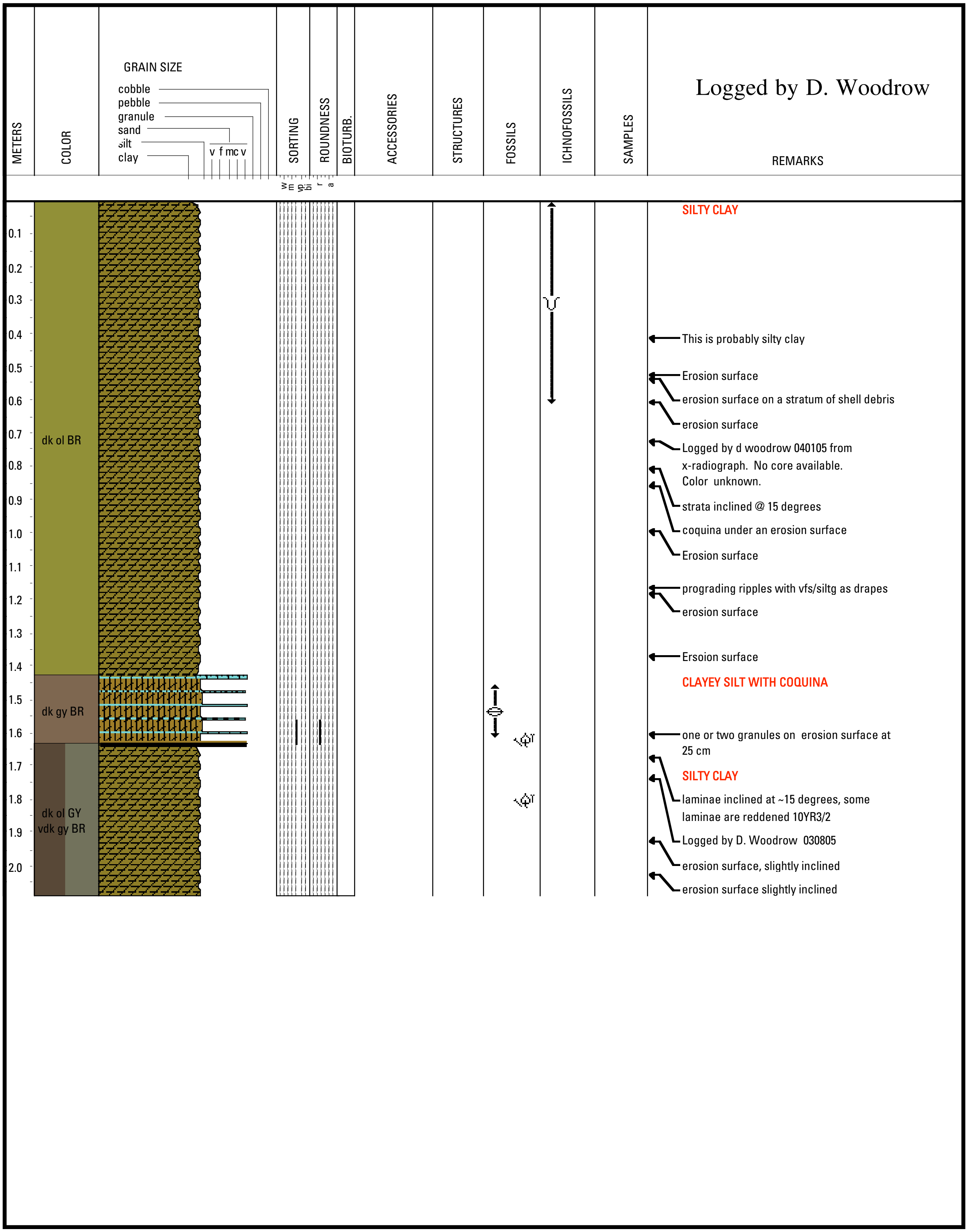
Collected: 1/1/1990
Water Depth: 13 meters
lat 37° 32' 16.9" N., long 122° 10' 30.6" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-34

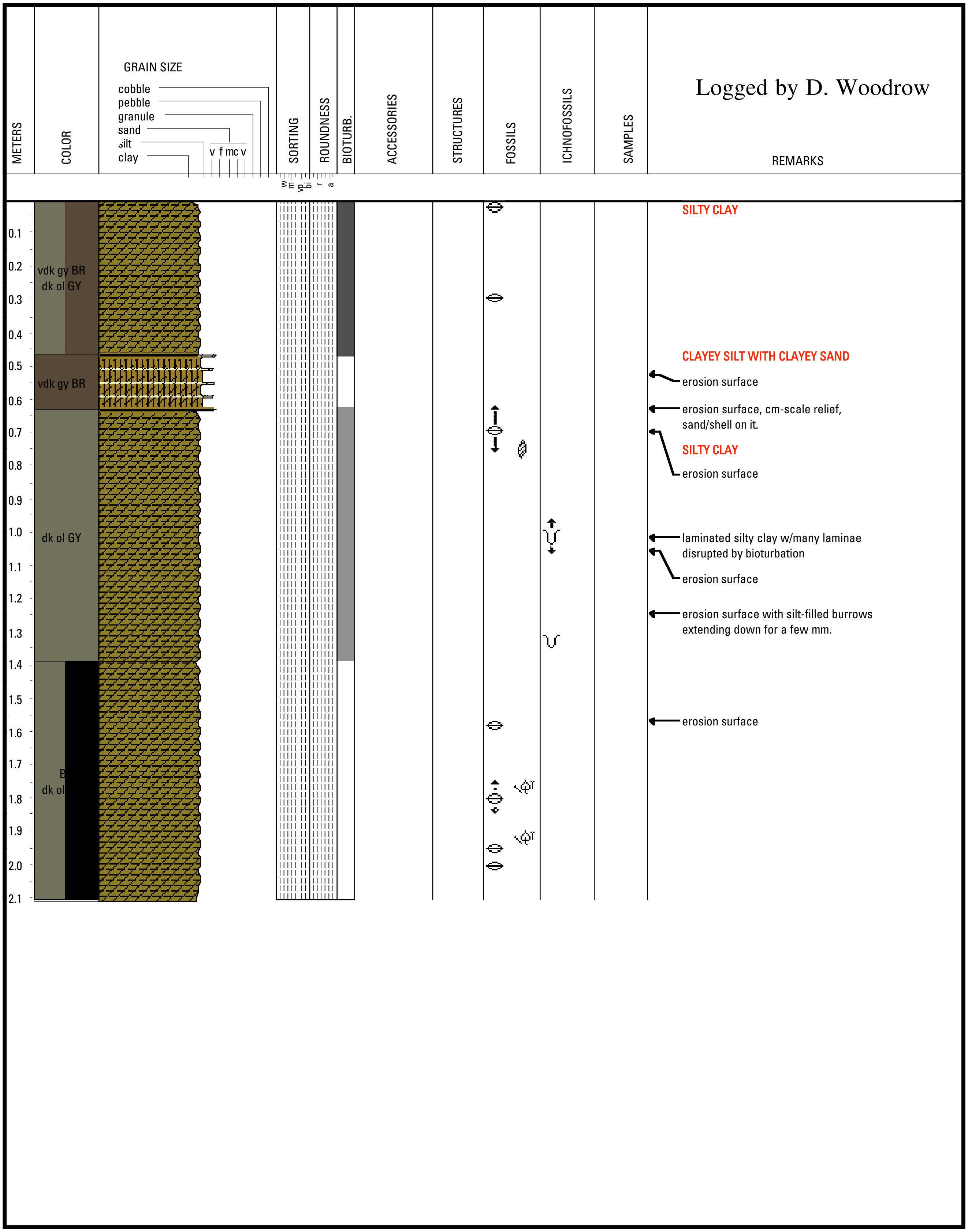
Collected: 1/1/1990
Water Depth: 9 meters
lat 37° 33' 11.2" N., long 122° 10' 25.2" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-35

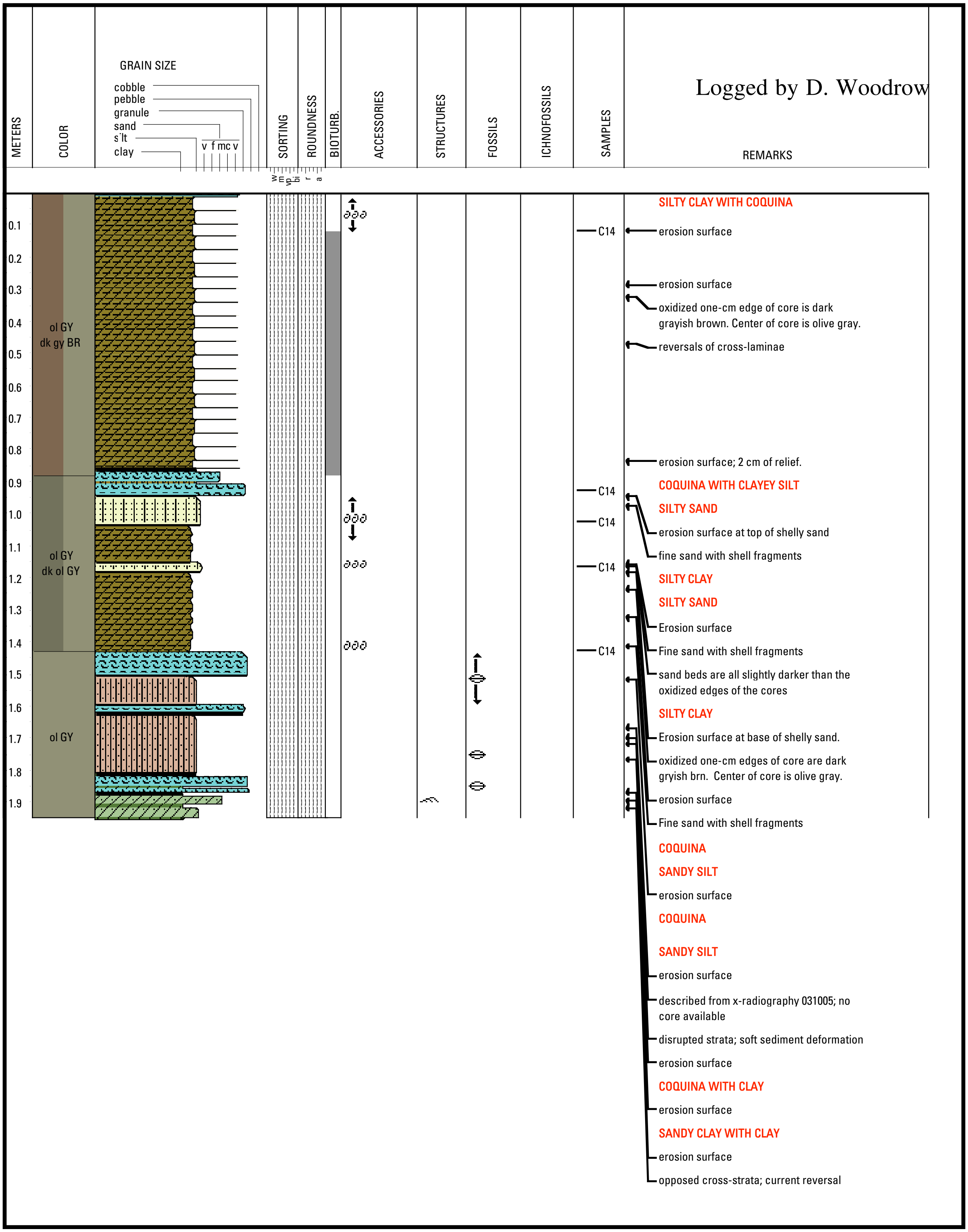
Collected: 1/1/1990
Water Depth: 11 meters
lat 37° 32' 28.4" N., long 122° 11' 2.5" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-36

Collected: 1/25/1990
Water Depth: 14 meters
lat 37° 33' .4" N., long 122° 10' 29.5" W. (WGS84 datum)

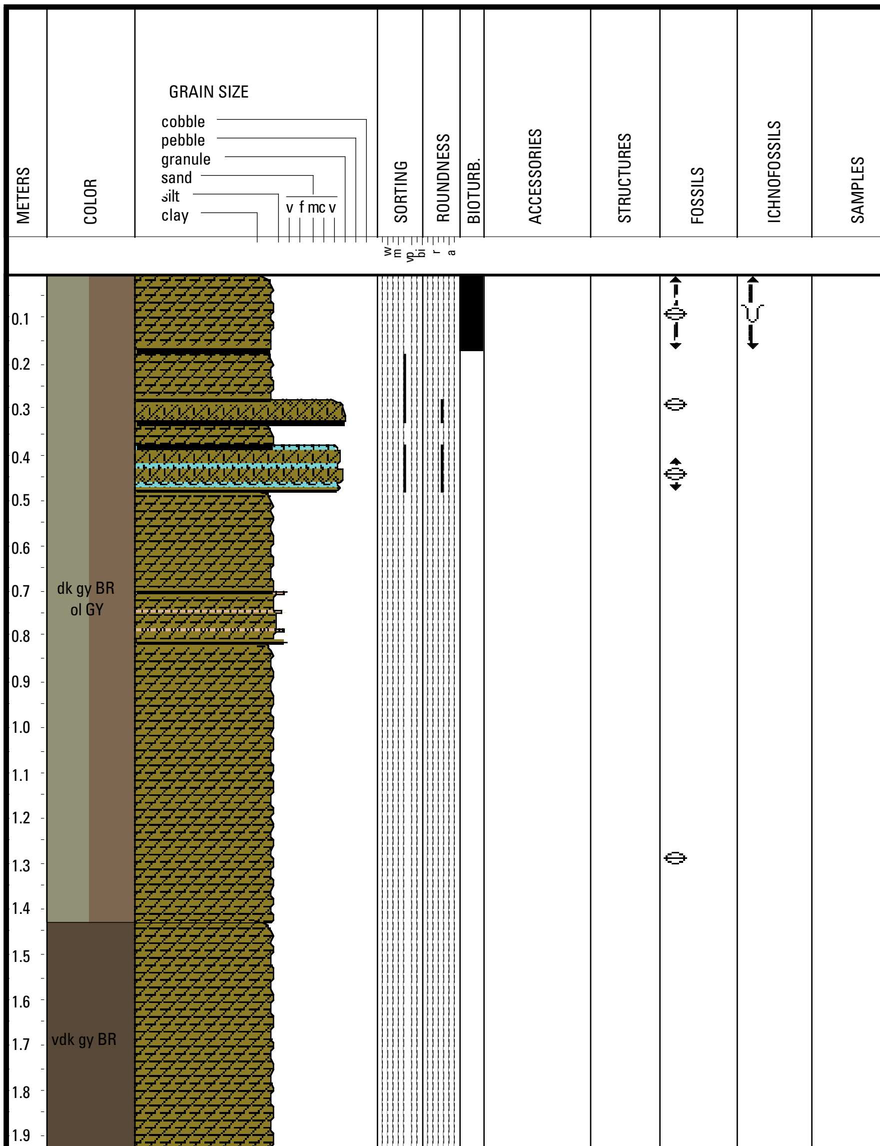


U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-37

Collected: 1/1/1990
Water Depth: 11 meters
lat 37° 33' 7.6" N., long 122° 10' 33.5" W. (WGS84 datum)

Logged by D. Woodrow



REMARKS

SILTY CLAY
small shell fragments
1 mm diam vertical burrows
erosion surface
GRAVELLY SILTY CLAY
erosion surface
pebble-sized, angular clasts on erosion surface
SILTY CLAY
erosion surface
erosion surface
GRAVELLY SILTY CLAY WITH COQUINA
Sandy clay with few pebbles
Erosion surface
SILTY CLAY
SILTY CLAY WITH SANDY SILT
described split core 020305, X-radiograph 020105
SILTY CLAY
Erosion surface with 15 cm of disturbed strata above.
Clay strata steeply inclined, broken with erosion surfaces top and bottom
Isolated clump of large shell fragments in a sequence of badly broken sediment
erosion surface with cut-and-fill above
erosion surface with truncated cross-strata below
described from split core 012105

U.S. GEOLOGICAL SURVEY

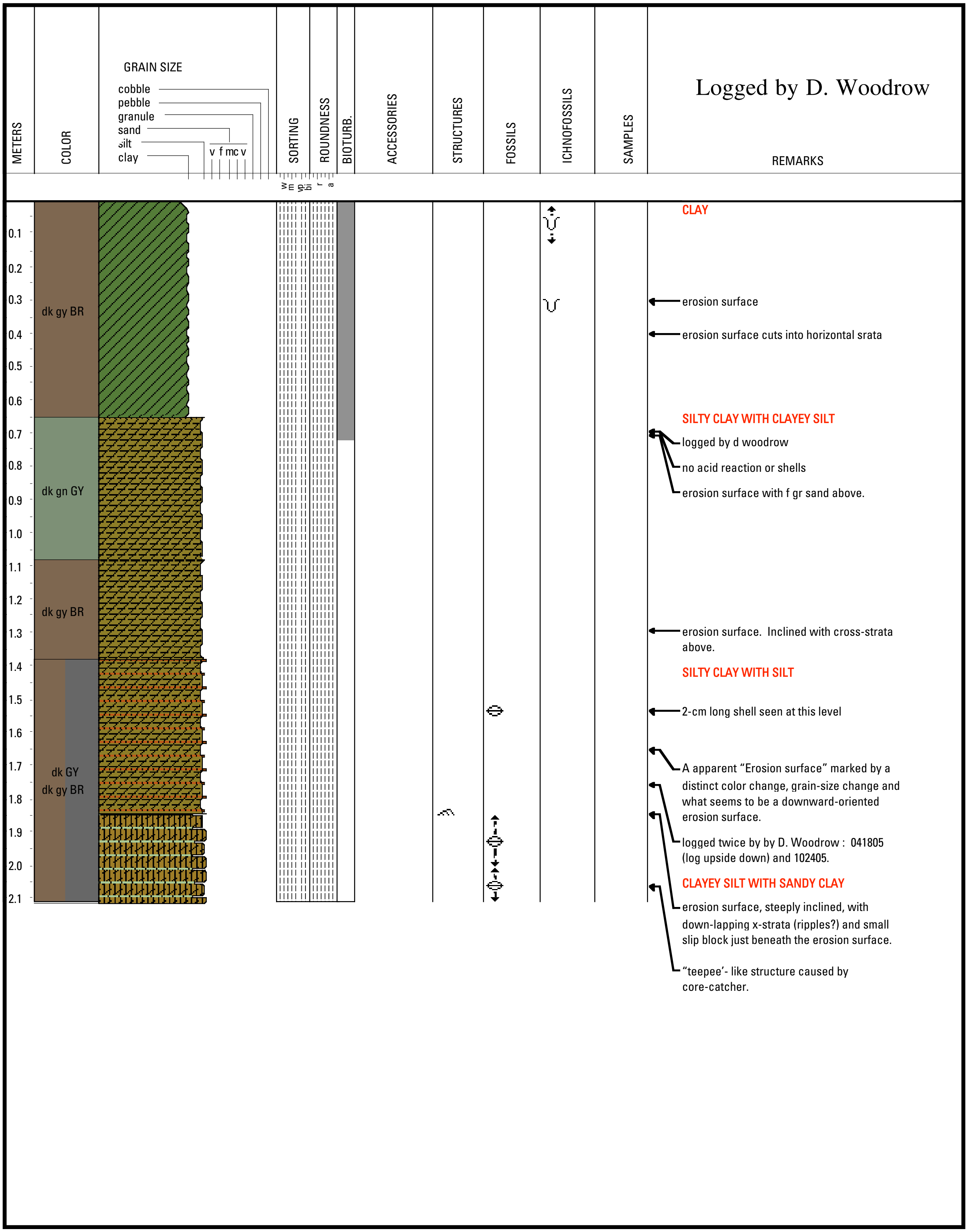
Collected: 1/26/1990

Cruise: J-2-90-SF

Water Depth: 6 meters

Site: 90-38

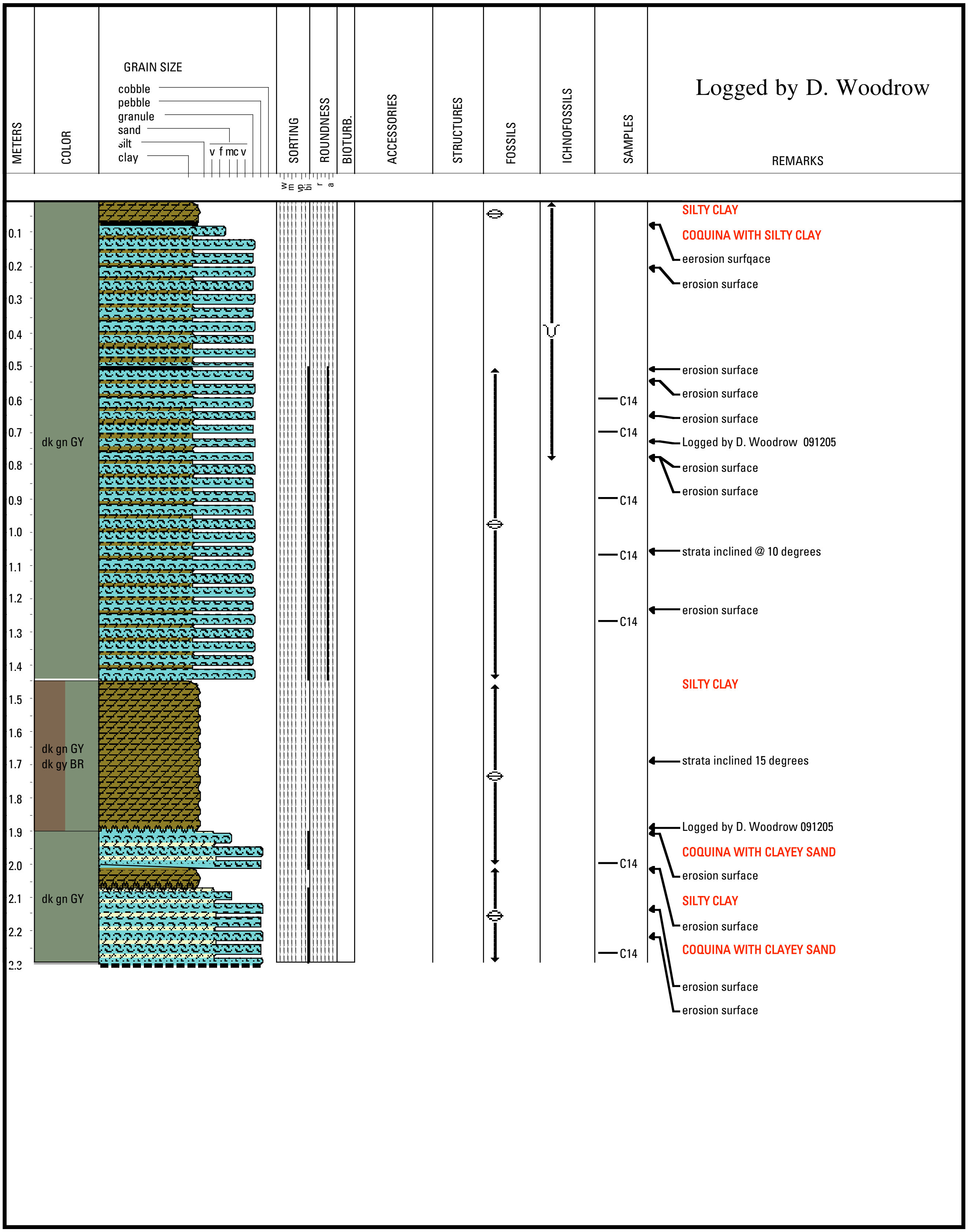
lat 37° 33' 18.4" N., long 122° 10' 23" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-142

Collected: 2/12/1990
Water Depth: 3 meters
lat 37° 34' 1.1" N., long 122° 14' 3.6" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

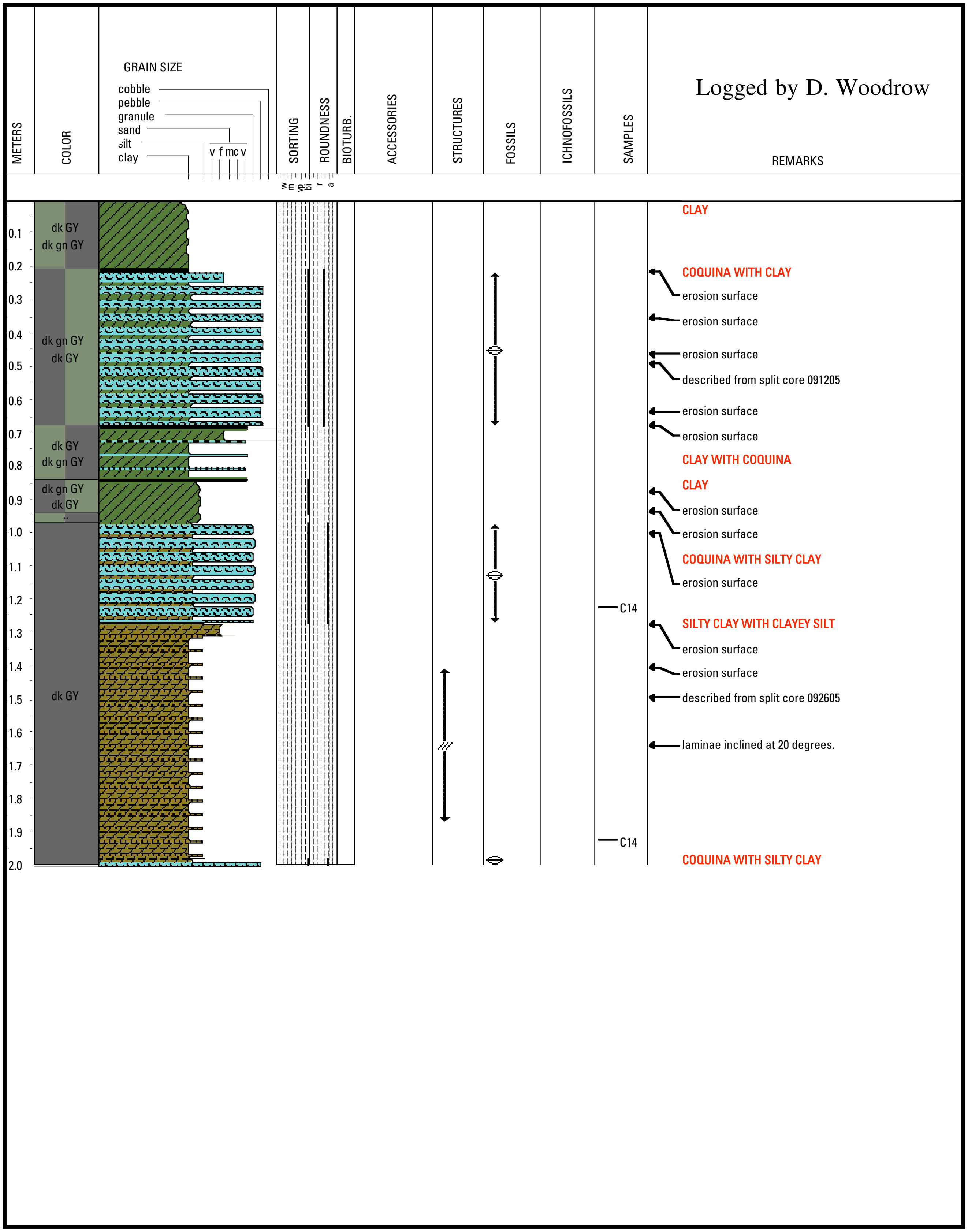
Collected: 2/12/1990

Cruise: J-2-90-SF

Water Depth: 0 meters

Site: 90-143

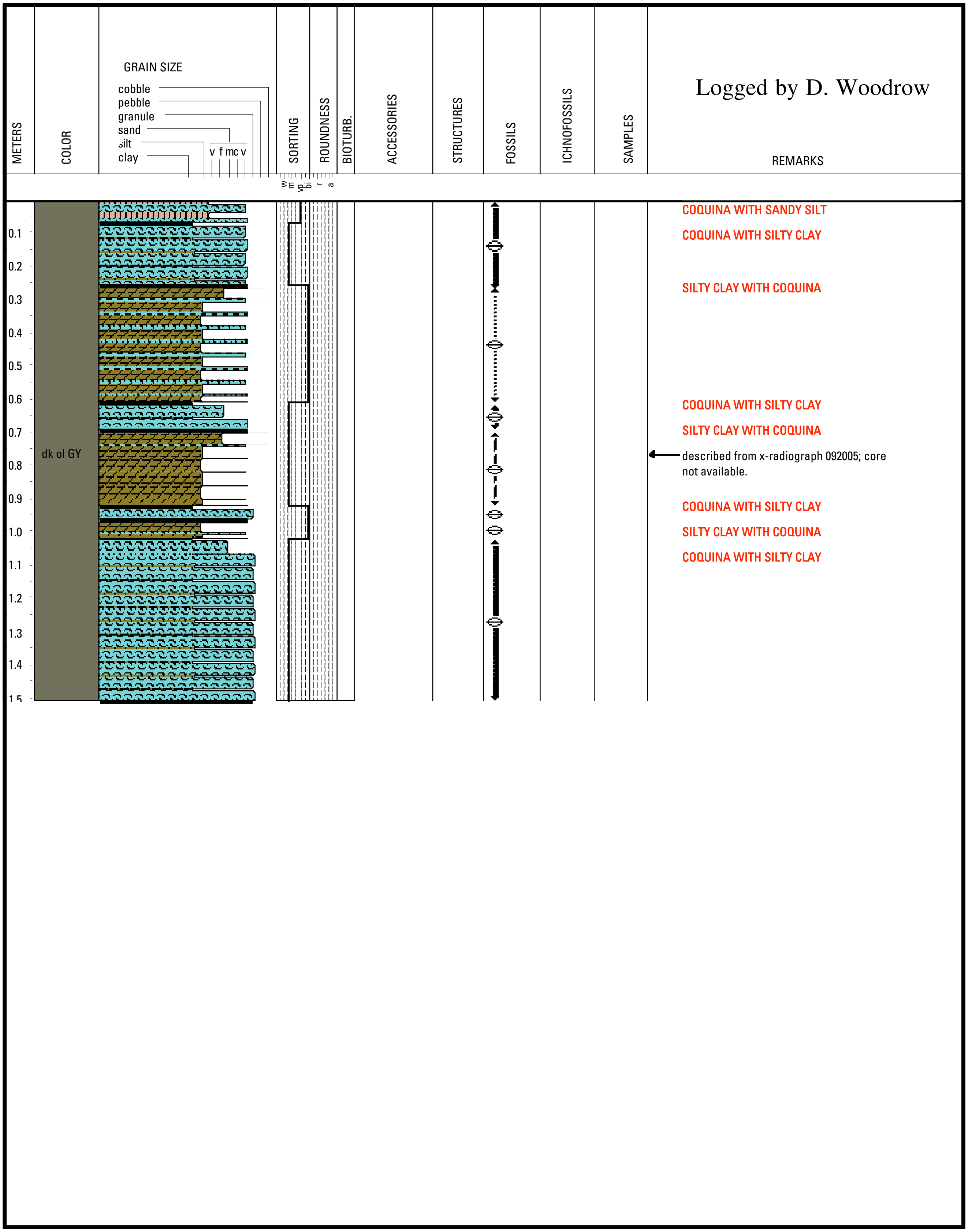
lat 37° 34' 4.3" N., long 122° 14' 1.1" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-144

Collected: 2/12/1990
Water Depth: 7 meters
lat 37° 34' 4" N., long 122° 13' 29.9" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

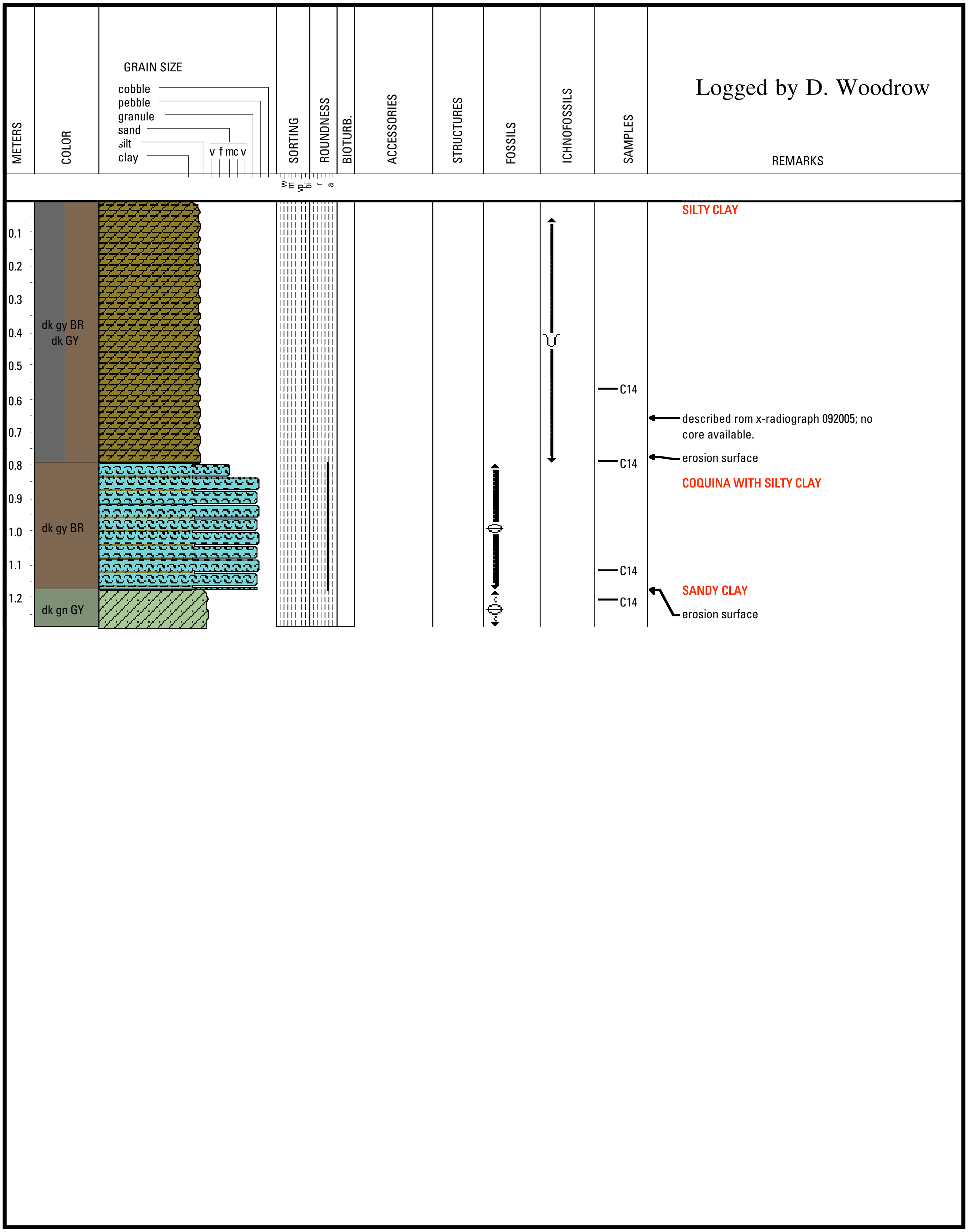
Collected: 2/12/1990

Cruise: J-2-90-SF

Water Depth: 11 meters

Site: 90-145

lat 37° 34' 8.6" N., long 122° 13' 34.6" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

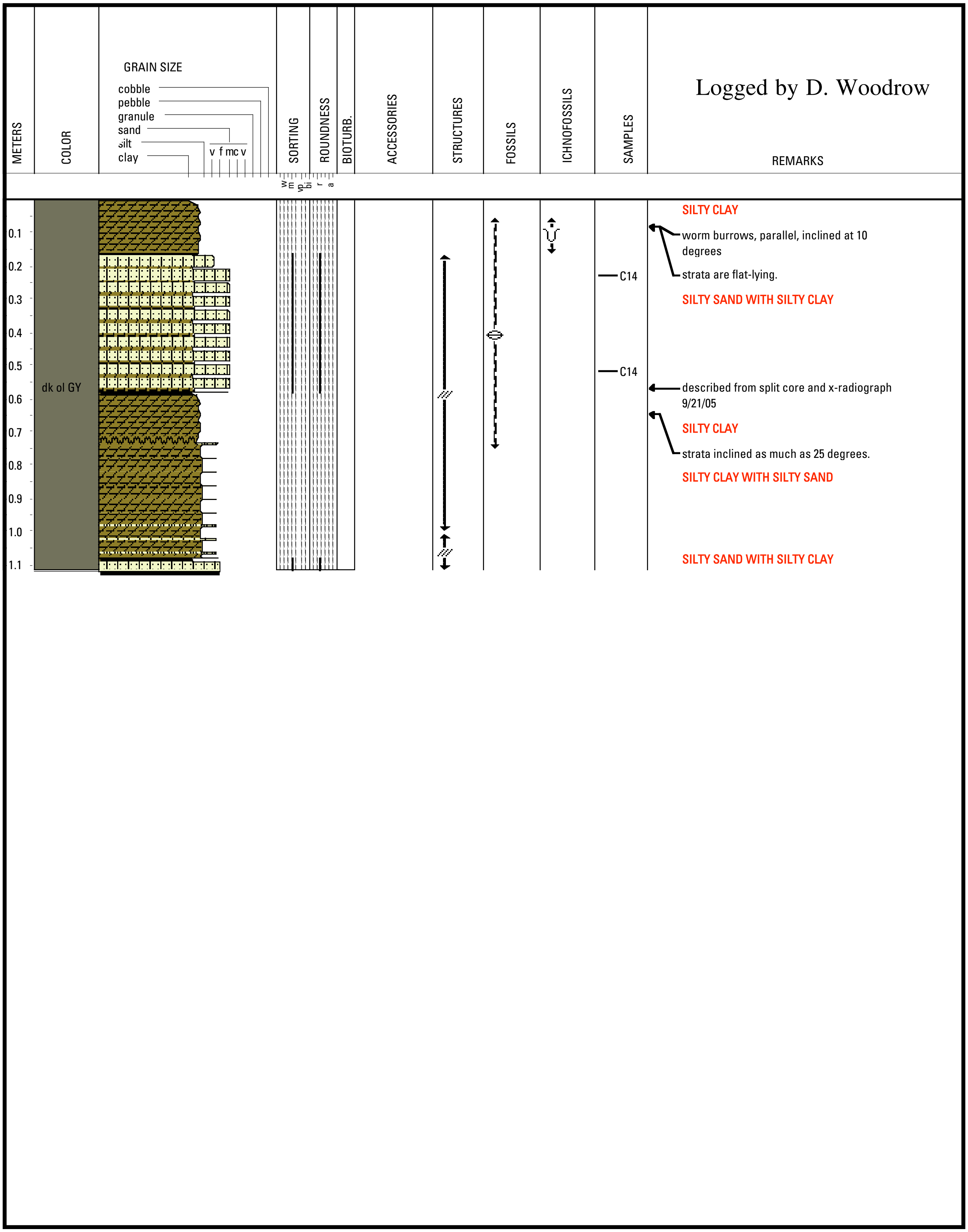
Collected: 2/12/1990

Cruise: J-2-90-SF

Water Depth: 15 meters

Site: 90-146

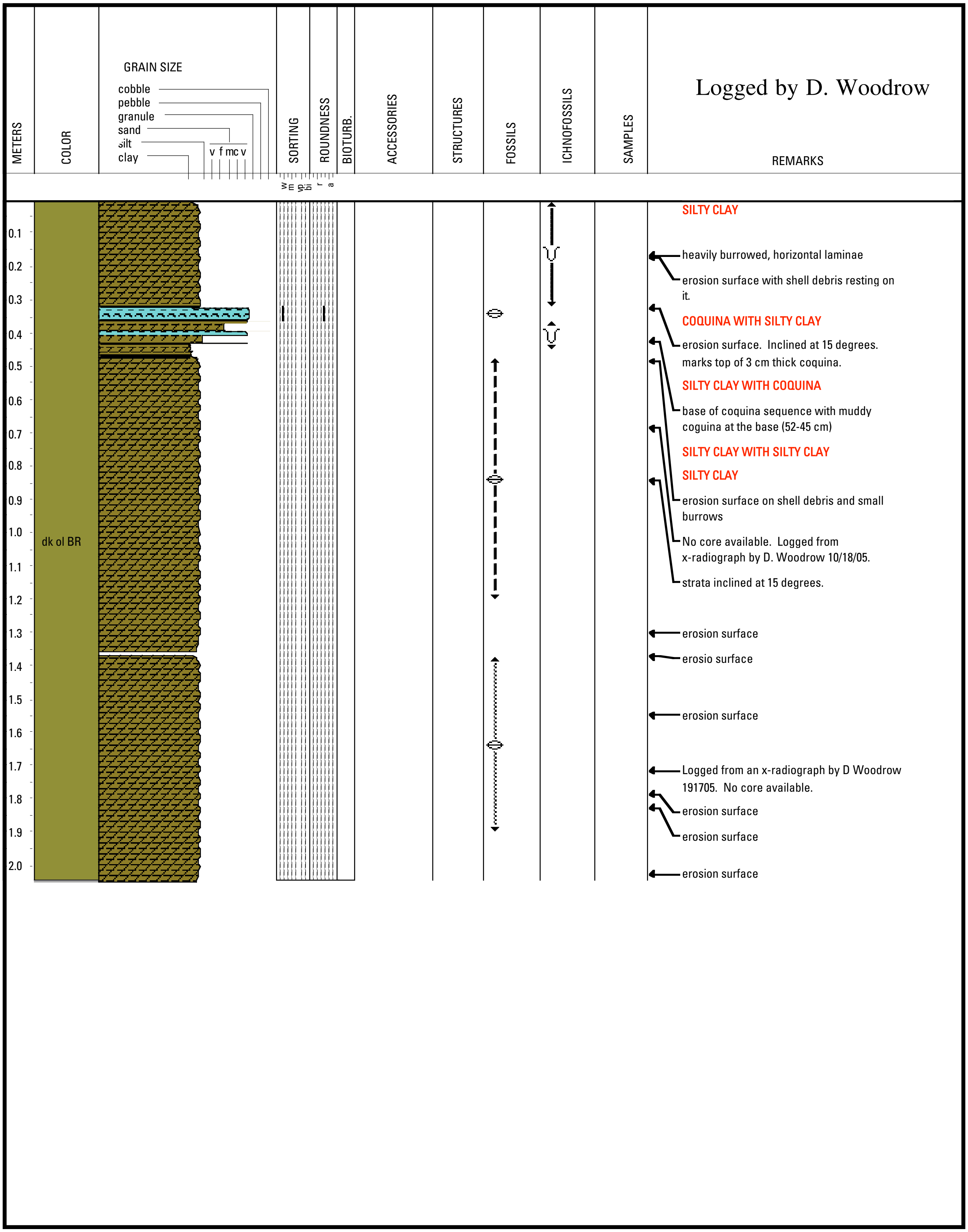
lat 37° 34' 12.6" N., long 122° 13' 21.6" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-148

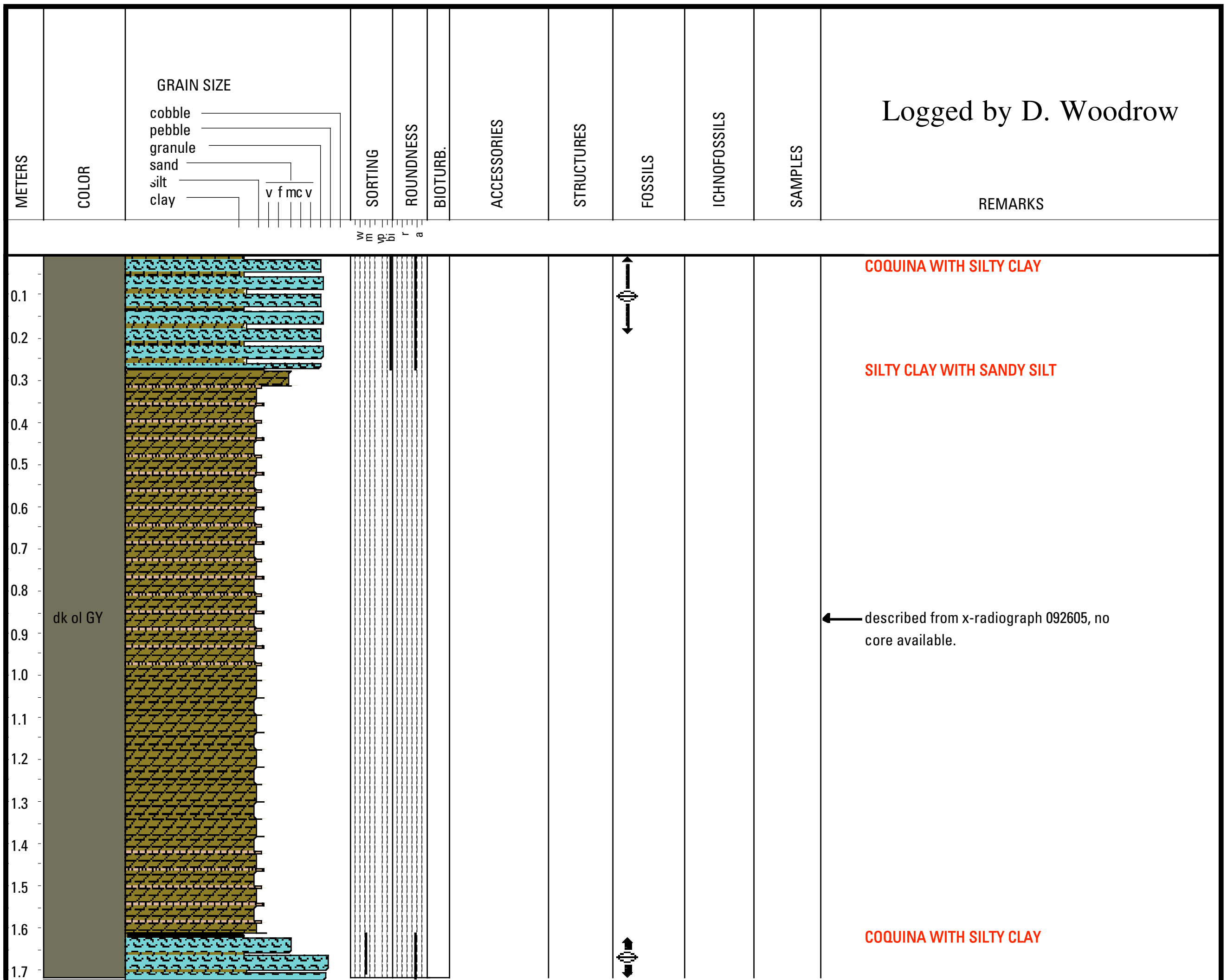
Collected: 2/12/1990
Water Depth: 6 meters
lat 37° 34' 16.9" N., long 122° 13' 10.4" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-149

Collected: 2/12/1990
Water Depth: 16 meters
lat 37° 34' 19.8" N., long 122° 13' 9.4" W. (WGS84 datum)

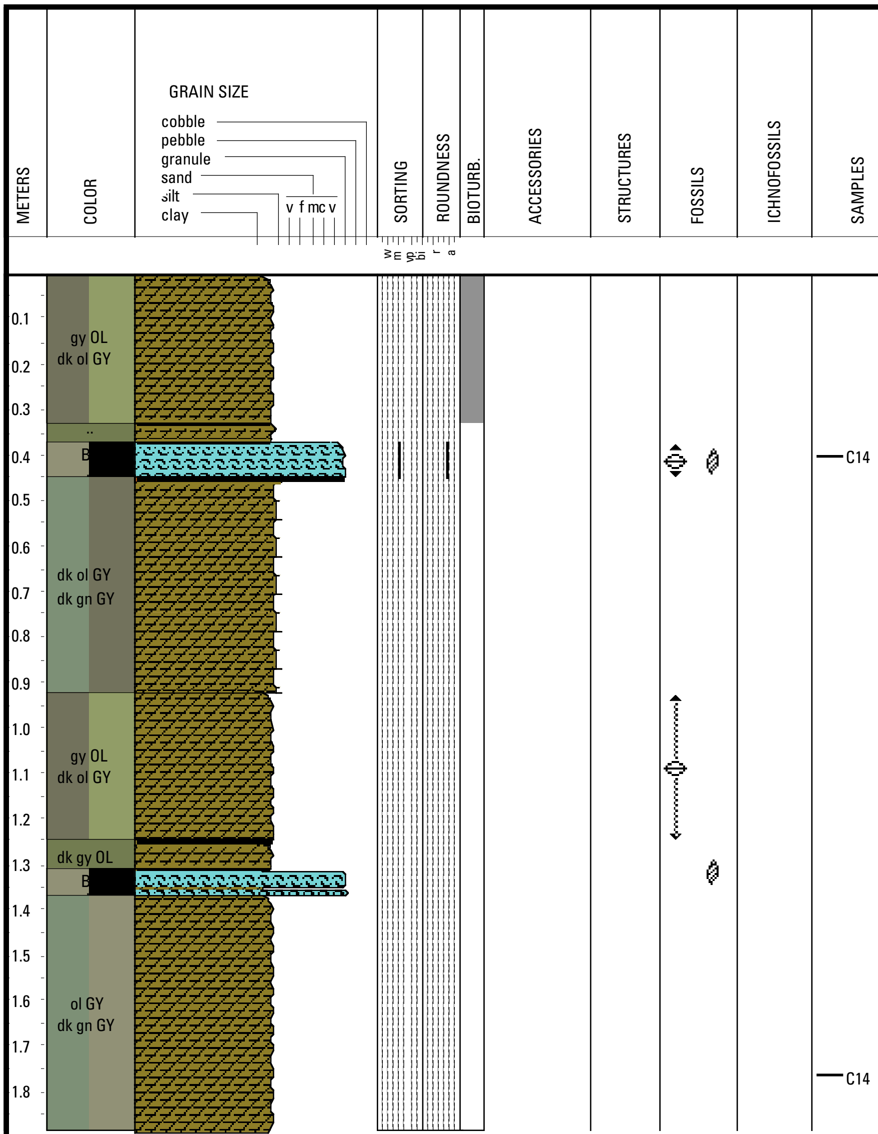


U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-150

Collected: 2/12/1990
Water Depth: 11 meters
lat 37° 34' 22.7" N., long 122° 13' 9.7" W. (WGS84 datum)

Logged by D. Woodrow



REMARKS

SILTY CLAY

lack of clearly defined laminae suggests bioturbation.

one cm gap

COQUINA

erosion surface

SILTY CLAY WITH SILT

erosion surface

Split core and x-radiograph logged by D. Woodrow 10/18/05

one cm gap

one cm gap inclined at ~ 10 degrees.

SILTY CLAY

COQUINA WITH SILTY CLAY

coquina is very muddy. mostly high-spired gastropods

SILTY CLAY

Much of the core gives off a strong sulfide odor with HCl.

All fractures are covered by a bright red, iron-oxide crust.

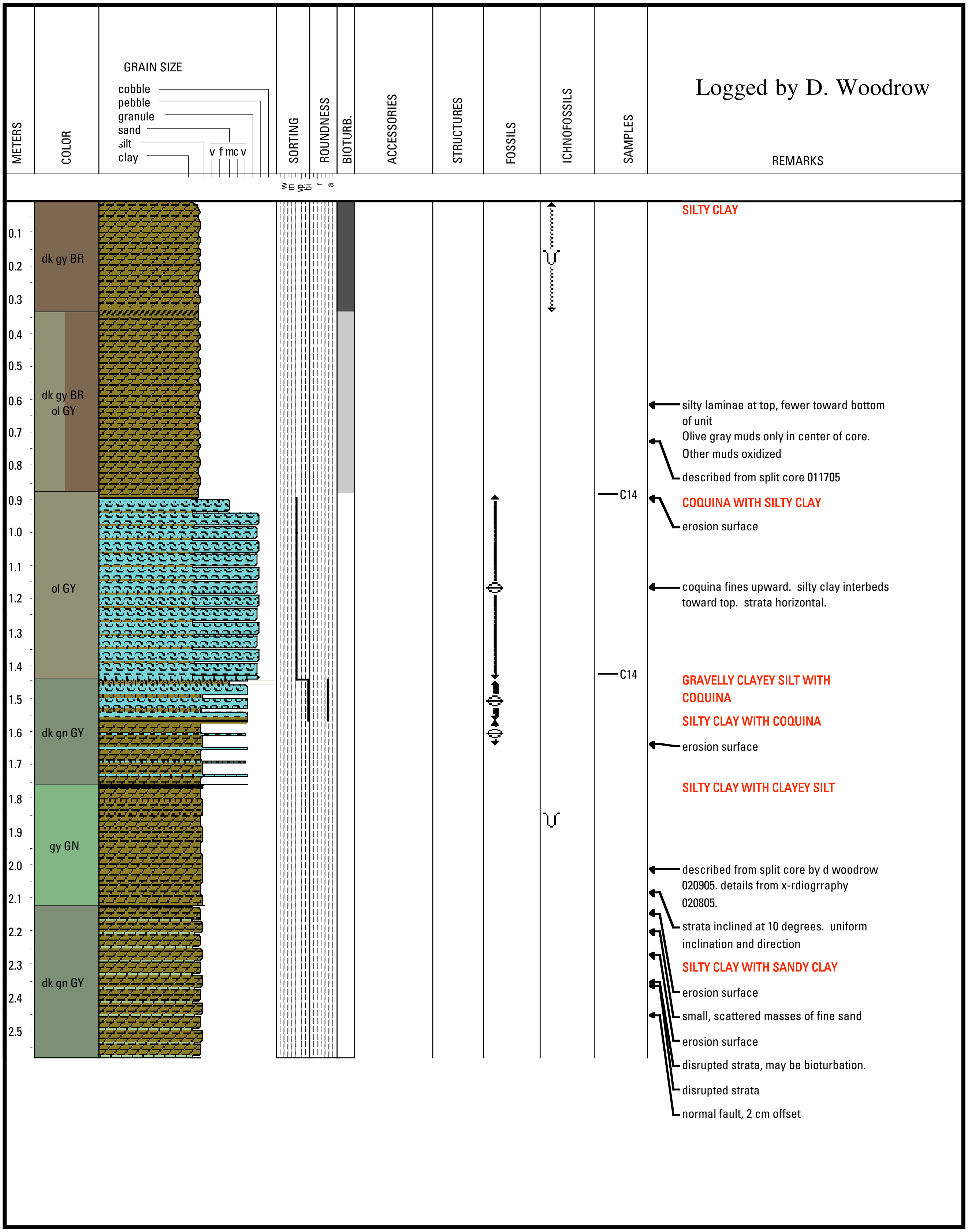
This is the gooiest core I have seen in the SFB cores

logged by d woodrow 021405 from single x-radiogaph for 90-150A and 90-150B.

U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-151

Collected: 2/12/1990
Water Depth: 4 meters
lat 37° 34' 28.8" N., long 122° 11' 20.5" W. (WGS84 datum)

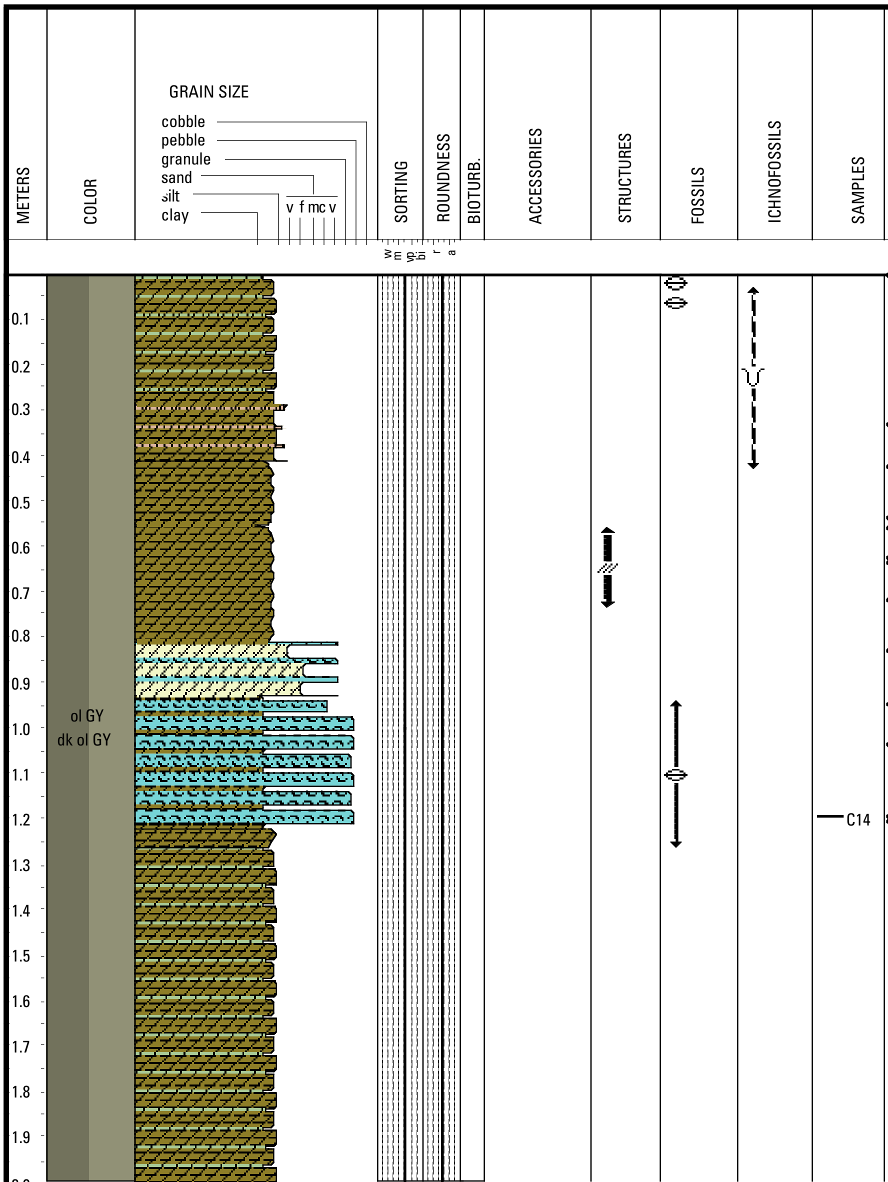


U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-174

Collected: 2/20/1990
Water Depth: 5 meters
lat 37° 36' 5.4" N., long 122° 15' 18.4" W. (WGS84 datum)

Logged by D. Woodrow



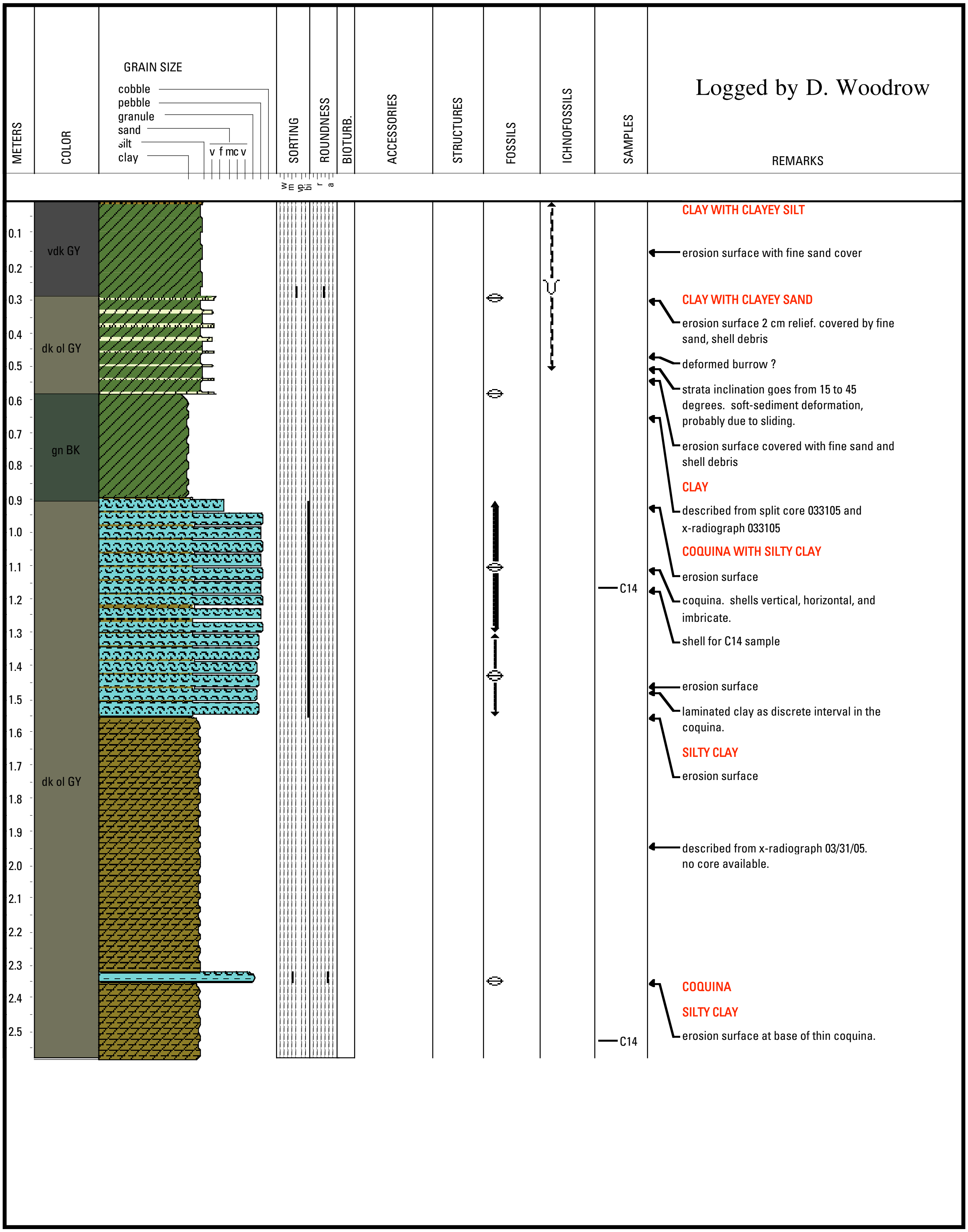
REMARKS

erosion surface
erosion surface covered by fine sand
erosion surface. shell protruding through it
erosion surface
erosion surface
erosion surface
erosion surface
two close spaced erosion surfaces both covered by fine sand
split core described by dwoodrow 040505. x-radiograph analysis 032805
SILTY CLAY WITH SANDY CLAY
SILTY CLAY WITH SANDY SILT
erosion surface
SILTY CLAY
erosion surface with fine sand cover
erosion surface with fine sand cover
erosion surface with fine sand cover
strata inclined at 20 degrees
described from split core 040505. x-radiograph described 032805
cut and fill
CLAYEY SAND WITH COQUINA
erosion surface with fine sand cover
COQUINA WITH SILTY CLAY
erosion surface at base of sand layer
erosion surface
erosion surface at base of coquina
shell sample for C14
SILTY CLAY
SILTY CLAY WITH SANDY CLAY

U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-175

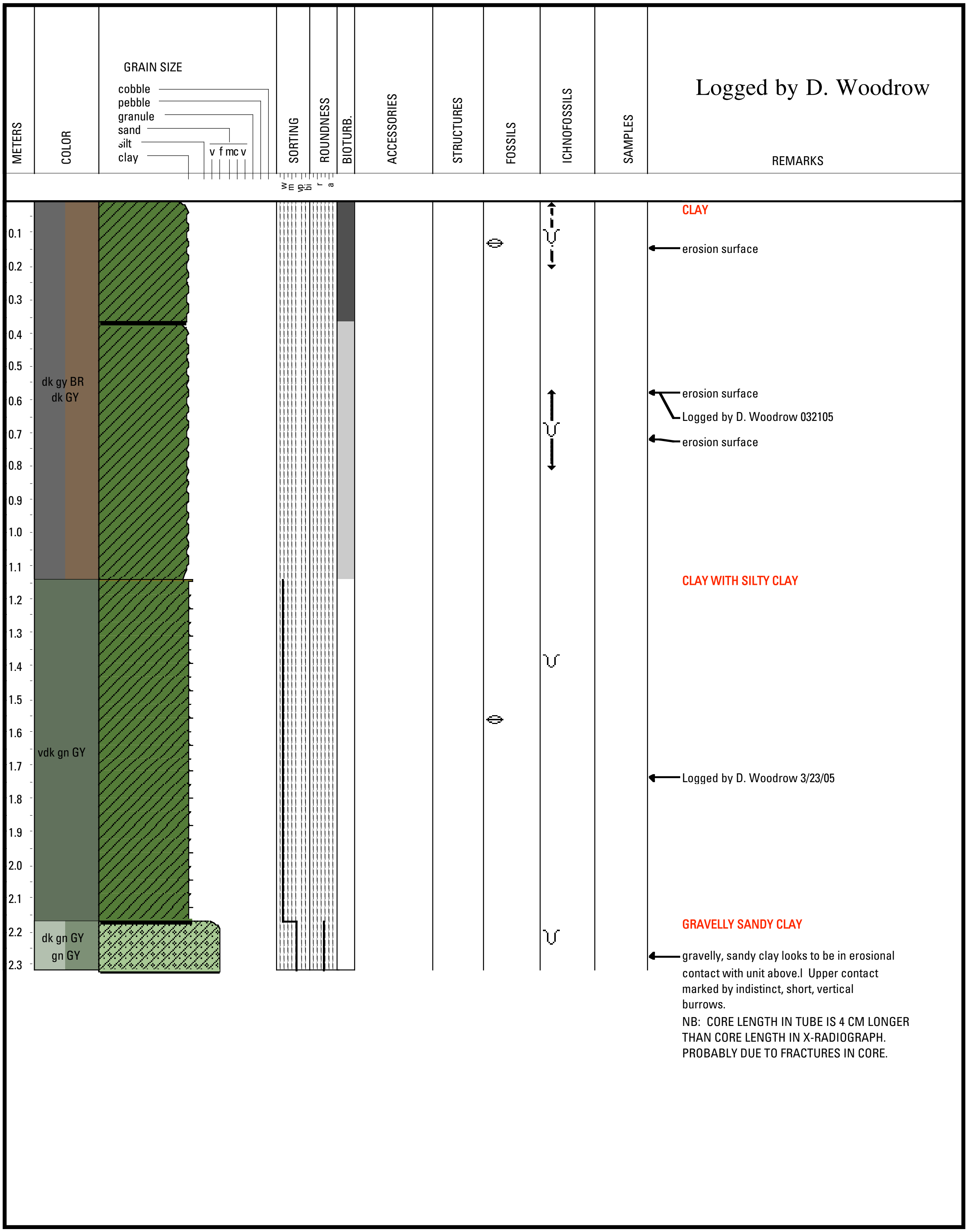
Collected: 2/20/1990
Water Depth: 5 meters
lat 37° 36' .4" N., long 122° 15' 20.5" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-176

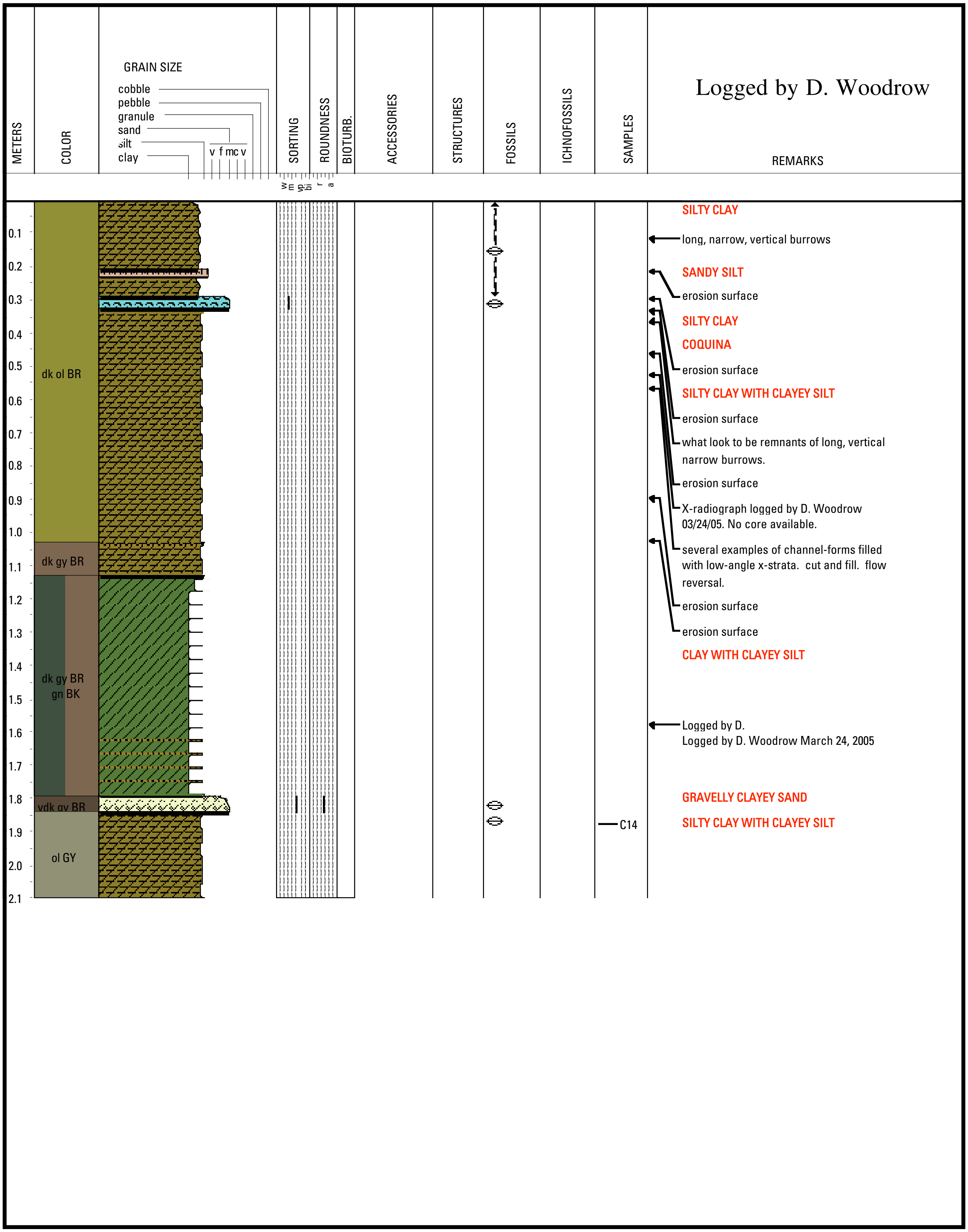
Collected: 2/20/1990
Water Depth: 0 meters
lat 37° 35' 32.4" N., long 122° 15' 24.5" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-177

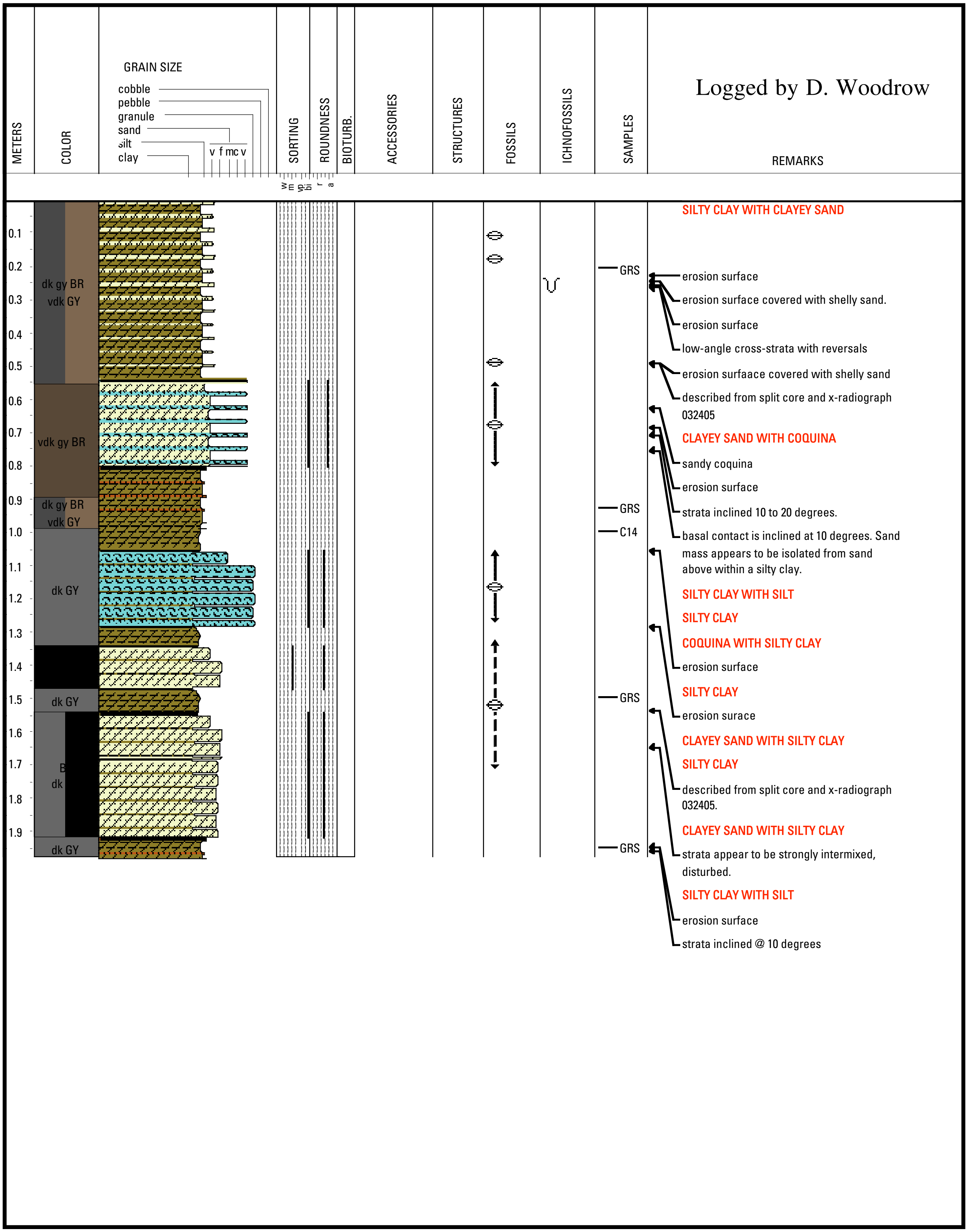
Collected: 2/20/1990
Water Depth: 14 meters
lat 37° 35' 26.3" N., long 122° 15' 22" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-178

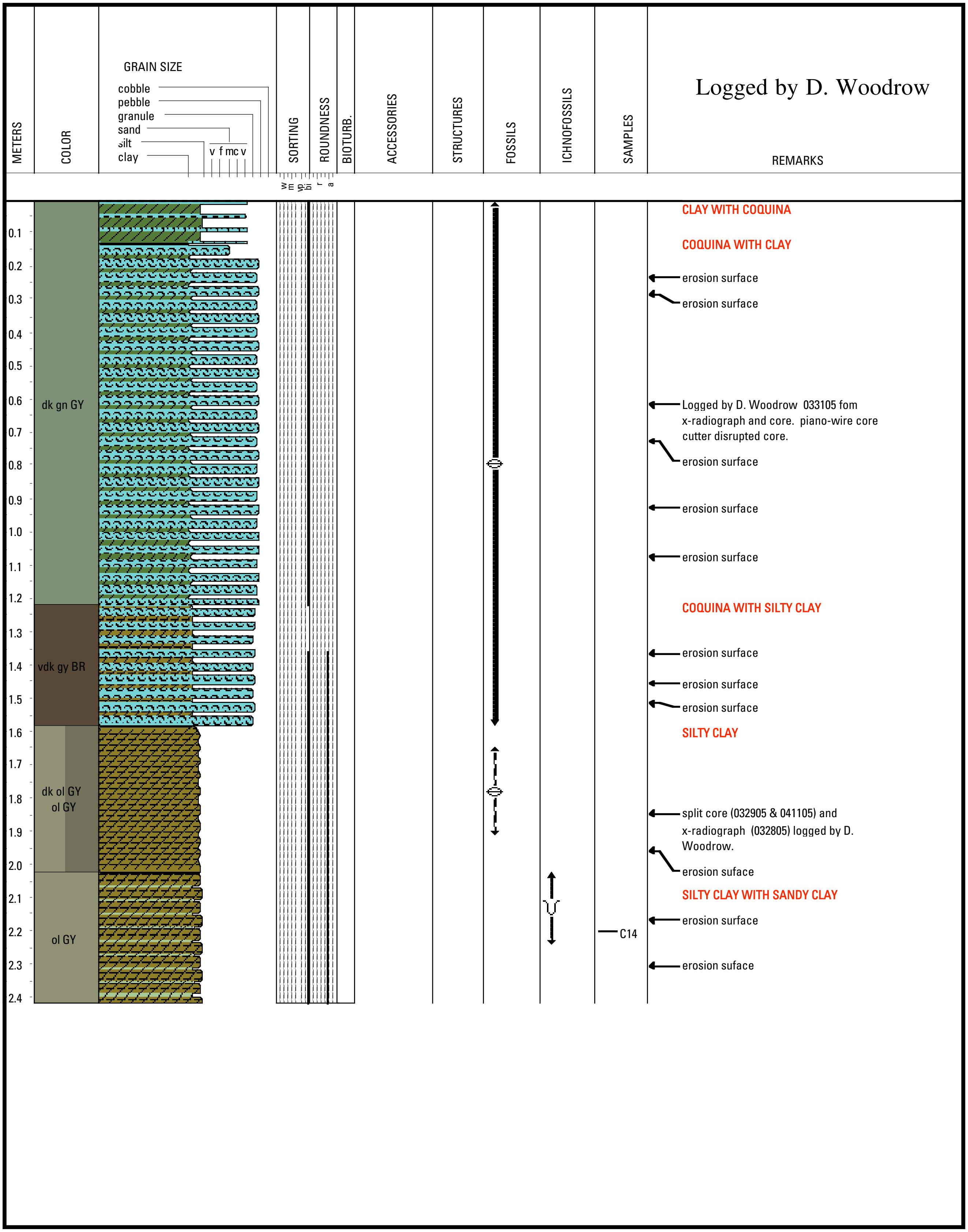
Collected: 2/20/1990
Water Depth: 17 meters
lat 37° 35' 19.1" N., long 122° 15' 31" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-179

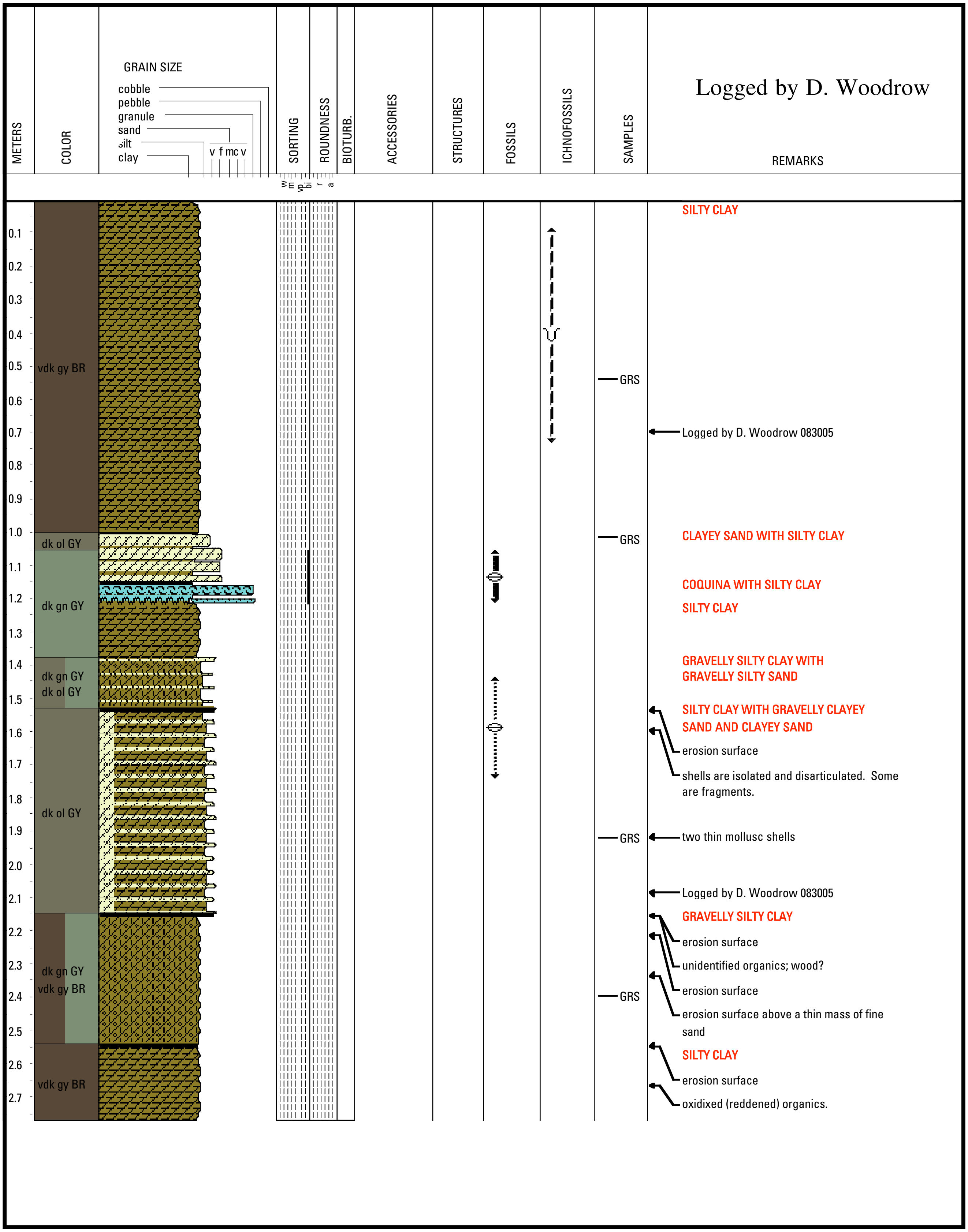
Collected: 2/20/1990
Water Depth: 4 meters
lat 37° 36' 16.2" N., long 122° 15' 7.6" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-180

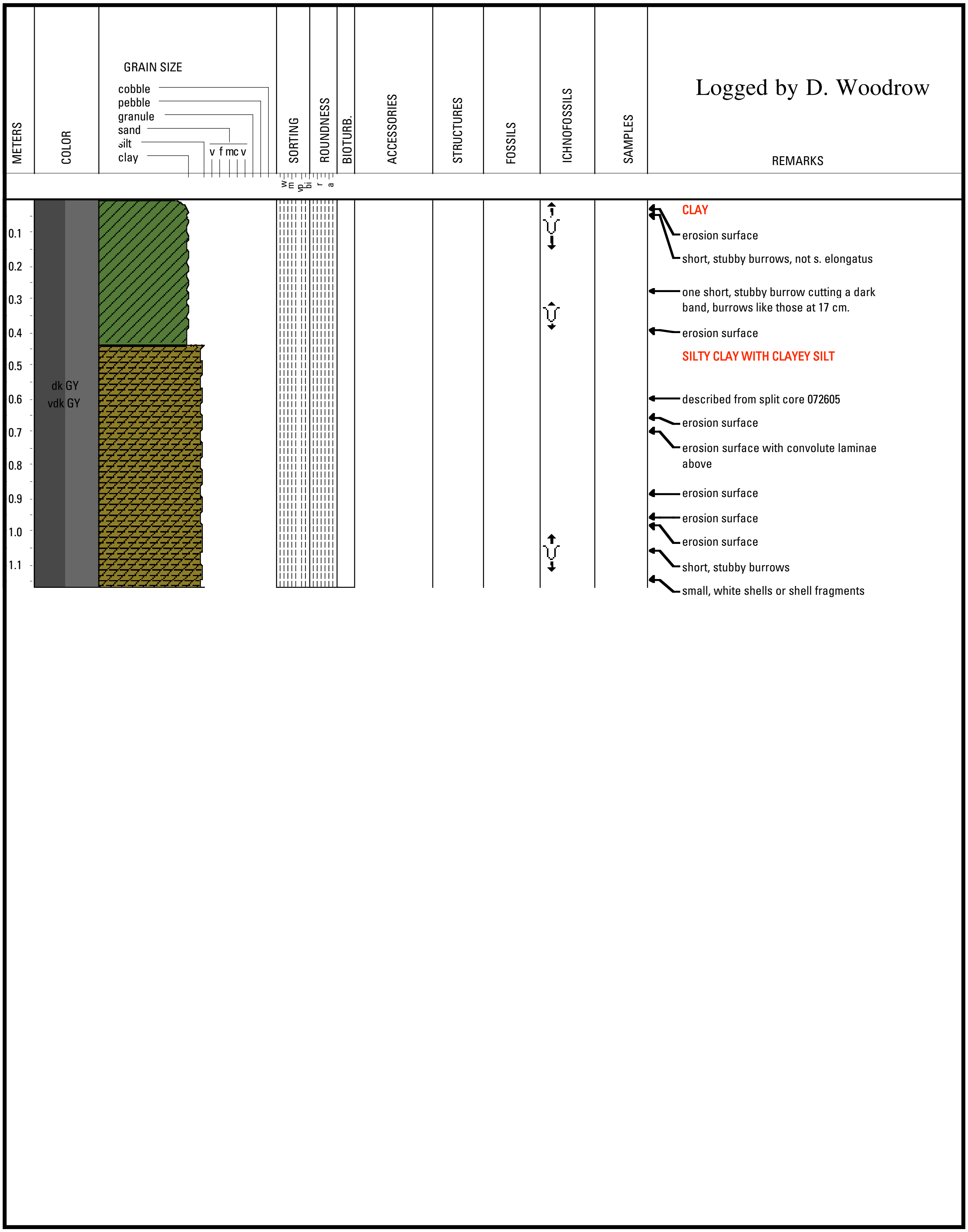
Collected: 2/20/1990
Water Depth: 0 meters
lat 37° 36' 13.3" N., long 122° 15' 12.2" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

Cruise: J-2-90-SF
Site: 90-193

Collected: 2/21/1990
Water Depth: 5 meters
lat 37° 29' 27.4" N., long 122° 5' 10.4" W. (WGS84 datum)



U.S. GEOLOGICAL SURVEY

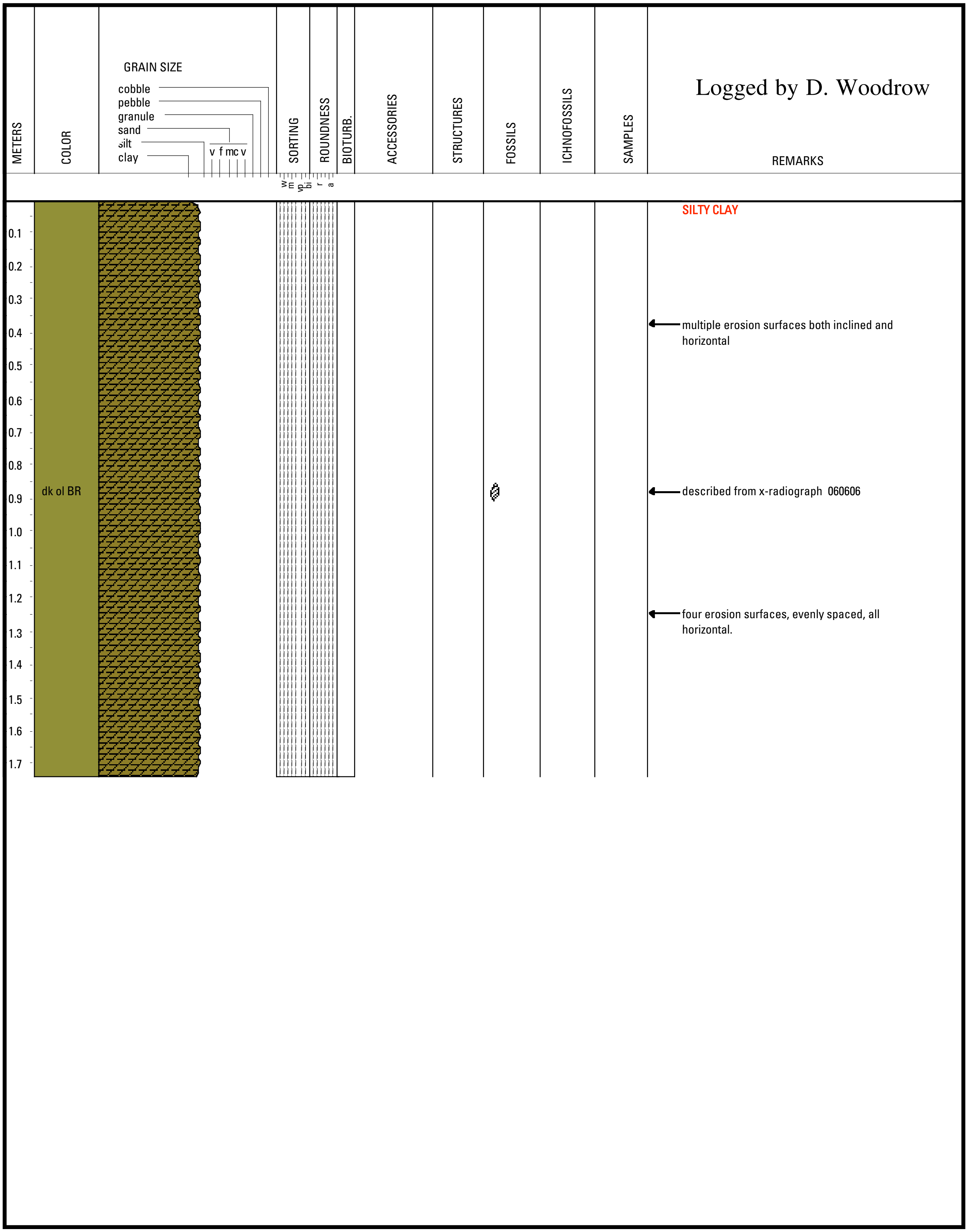
Collected: 2/21/1990

Cruise: J-2-90-SF

Water Depth: 5 meters

Site: 90-195

lat 37° 29' 27.4" N., long 122° 5' 10.4" W. (WGS84 datum)

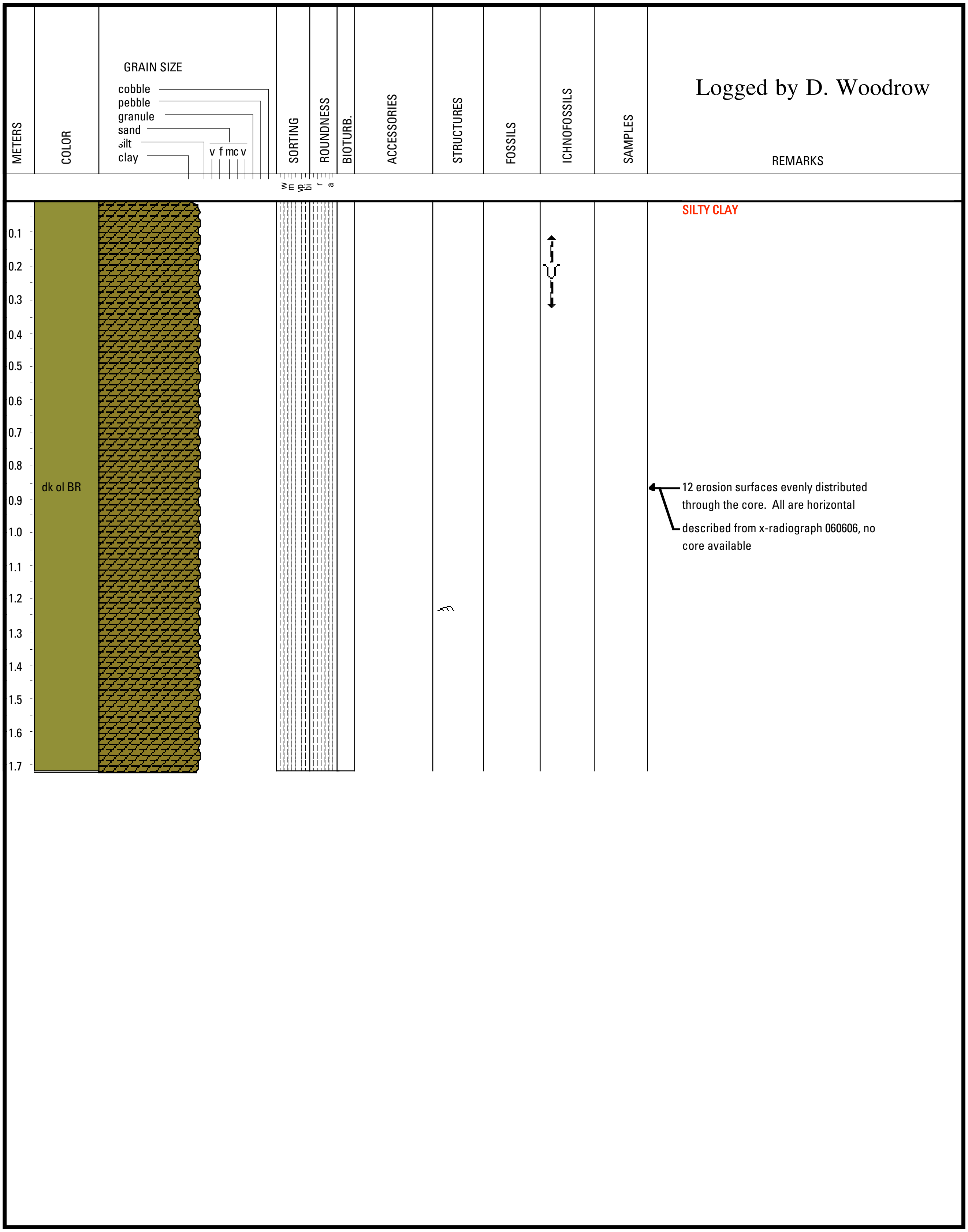


U.S. GEOLOGICAL SURVEY

Collected: 2/21/1990

Cruise: J-2-90-SF
Water Depth: 3 meters

Site: 90-197
lat 37° 29' 30.2" N., long 122° 5' 19.8" W. (WGS84 datum)



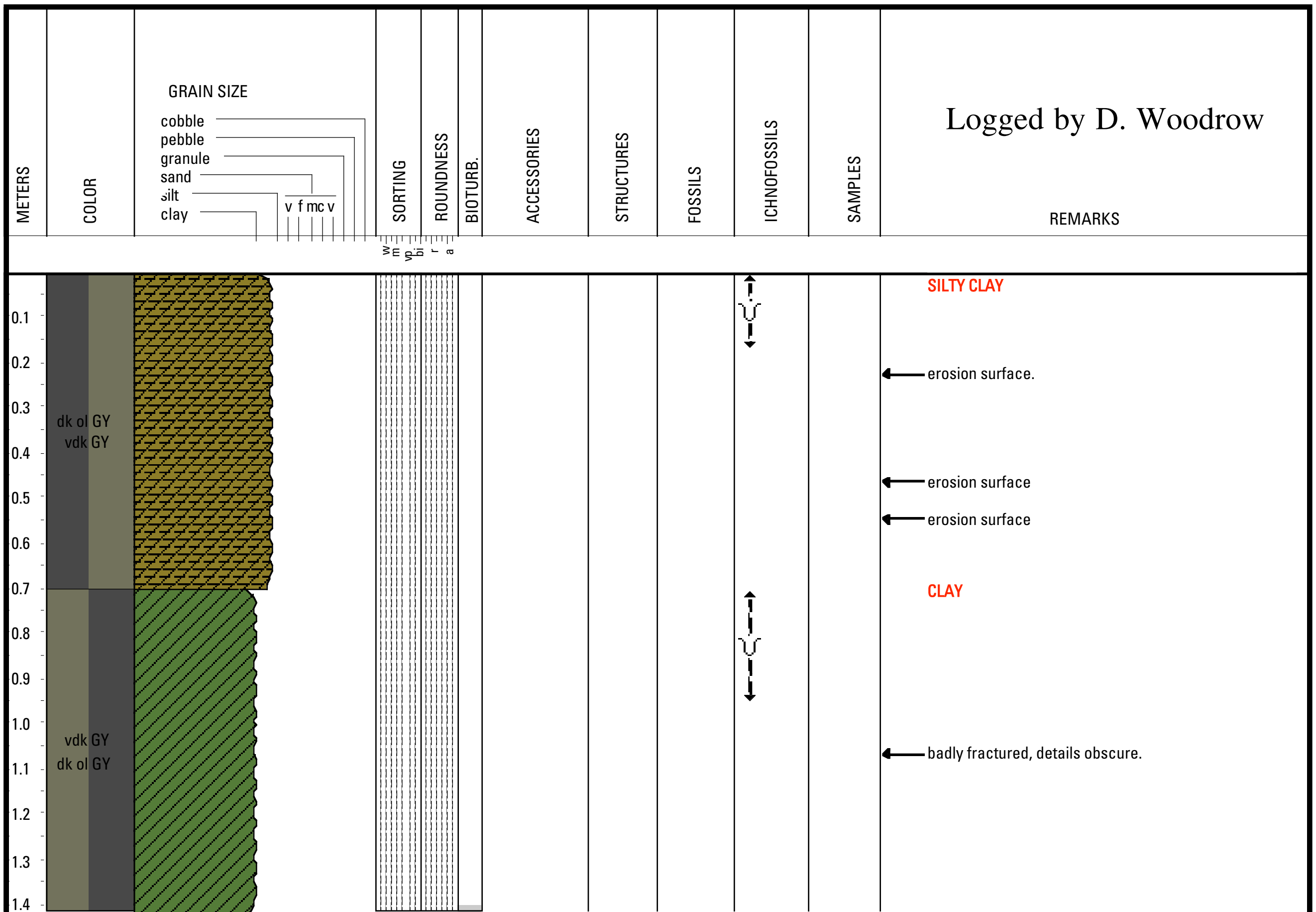
U.S. GEOLOGICAL SURVEY

Collected: 2/21/1990

Cruise: J-2-90-SF
Water Depth: 8 meters

Site: 90-198
lat 37° 29' 30.2" N., long 122° 5' 26.6" W. (WGS84 datum)

Logged by D. Woodrow



Appendix 4. Tables of sample collection and sample inventory for south San Francisco Bay gravity cores

Table A2. Sample Collection attributes from *http://walrus.wr.usgs.gov/infobank/j/j190sf/html/j-1-90-sf.meta.html* and *http://walrus.wr.usgs.gov/infobank/j/j290sf/html/j-2-90-sf.meta.html*.

Sample Id	Navigation Time[1]	Latitude	Longitude	Activity ID (cruise)	Collection Device	Depth (m)	Original Sample Id	Sample Collection Comments
90-1	19900200000001	37.46083	-122.04717	j190sf	gravity core	4.4	1-g-23	1 Recovered 200 lb 3.0 m barrel (G) Coyote Crk Mouth N. Bank, Faintly Stiff Mud, South San Francisco Bay, South of the Dumbarton Bridge
90-2	19900200000002	37.46083	-122.04717	j190sf	gravity core	2.0	2-g-23	2 Recovered 200 lb 3.0 m barrel (G) Coyote Crk Mouth Up Slope, Less Cohesive Mud at the Surface, South San Francisco Bay, South of the Dumbarton Bridge
90-3	19900200000003	37.46167	-122.04467	j190sf	gravity core	2.0	3-g-23	3 Recovered 3.0 m barrel (G) Coyote Crk Mouth E. of #2 N. Bank, Probable Compaction Shelly Mud, South San Francisco Bay, South of the Dumbarton Bridge
90-4	19900200000004	37.45950	-122.05283	j190sf	gravity core	3.3	4-g-23	4 Recovered 3.0 m barrel (G) btwn Coyote Crk & Guadalupe Slough In the Thalweg, Lower Slowly, Shell Hash at Top, South San Francisco Bay, South of the Dumbarton Bridge
90-5	19900200000005	37.46833	-122.05567	j190sf	gravity core	2.7	5-g-23	5 Recovered 3.0 m barrel (G) Upper Subtidal Flats NW of Calaveras Pt., Lower Slowly, Shell Hash at Top, South San Francisco Bay, South of the Dumbarton Bridge
90-6	19900200000006	37.48200	-122.07633	j190sf	gravity core	7.5	6-g-23	6 Recovered 3.0 m barrel (G) Channel Slope N. of Marker #17, Free Fall, some Shelly Material at the Top, South San Francisco Bay, South of the Dumbarton Bridge
90-7	19900200000007	37.48717	-122.08150	j190sf	gravity core	5.0	7-g-23	7 Recovered 3.0 m barrel (G) South of Marker #17 On Shoal Area, Free Fall, Shell Lag at Top and Bottom, South San Francisco Bay, South of the Dumbarton Bridge
90-8	19900200000008	37.49283	-122.07867	j190sf	gravity core	3.8	1-g-24	8 Recovered 3.0 m barrel (G) Mouth of Mowry Slough N. Side, Compacting Sediment Buried Head Layer of Coarse Material 50 Cm Below the Top, South San Francisco Bay, South of the Dumbarton Bridge

Sample Id	Navigation Time[1]	Latitude	Longitude	Activity ID (cruise)	Collection Device	Depth (m)	Original Sample Id	Sample Collection Comments
90-9	19900200000009	37.49283	-122.08367	j190sf	gravity core	6.0	2-g-24	9 Recovered 1.75 m barrel (G) Down Slope From #8 at Mouth of Mowry Slough NE Mkr #16, Top Disturbed Free Fall, South San Francisco Bay, South of the Dumbarton Bridge
90-10	19900200000010	37.48883	-122.08683	j190sf	gravity core	6.3	3-g-24	10 Recovered 3.0 m barrel (G) West of Marker #16 On Shoal Area Across From Mouth of Newark Slough, Coarse Layer 25 Cm From Top, South San Francisco Bay, South of the Dumbarton Bridge
90-12	19900200000012	37.49150	-122.10150	j190sf	gravity core	8.3	5-g-24	12 Recovered 3.0 m barrel (G) Thalweg Down Slope From #11, Shell Lag and Stiff Mud at the Bottom, Shell Fragments On Top, South San Francisco Bay, South of the Dumbarton Bridge
90-13	19900200000013	37.49567	-122.09983	j190sf	gravity core	5.0	6-g-24	13 Recovered 3.0 m barrel (G) On Channel Slope Near Mouth of Newark Slough, Faintly Stiff Mud at Bottom, South San Francisco Bay, South of the Dumbarton Bridge
90-19	19900200000016	37.52033	-122.14183	j190sf	gravity core	11.0	12-g-24	19 Recovered 3.0 m barrel (G) North Side of Channel In Line With #18 Along the Thalweg, Free Fall, South San Francisco Bay, Between the San Mateo and Dumbarton Bridge
90-20	19900300000001	37.52183	-122.14300	j190sf	gravity core	18.0	1-g-25	20 Recovered 2.5 m barrel (G) North of #19 Along Thalweg, Oyster Shells In Core Catcher, Shell With Sandy Silt On Bottom, Top Has Shells, Tube Worms, Silt, South San Francisco Bay, Between the San Mateo and Dumbarton Bridge
90-21	19900300000002	37.52417	-122.14250	j190sf	gravity core	14.7	2-g-25	21 Recovered 2.5 m barrel (G) Along the Break In Slope In Line With #20, Shells and Sand at the Bottom, South San Francisco Bay, Between the San Mateo and Dumbarton Bridge
90-22	19900300000003	37.52533	-122.14183	j190sf	gravity core	5.2	3-g-25	22 Recovered 3.0 m barrel (G) Up Slope From # 21 North Side of Main Channel, Free Fall, Buried the Head, Bottom: Fairly Clean Mud, Top: Real Clean Mud, A Few Burrows, South San Francisco Bay, Between the San Mateo and Dumbarton Bridge
90-23	19900300000004	37.52650	-122.14067	j190sf	gravity core	7.2	4-g-25	23 Recovered 2.5 m barrel (G) Up Slope of #22 On the Subtidal Flat, Buried Head, Clean Mud at the Bottom, Top: Clean Mud, A Few Burrows, South San Francisco Bay, Between the San Mateo and Dumbarton Bridge

Sample Id	Navigation Time[1]	Latitude	Longitude	Activity ID (cruise)	Collection Device	Depth (m)	Original Sample Id	Sample Collection Comments
90-24	19900300000005	37.53033	-122.16233	j190sf	gravity core	6.2	5-g-25	24 Recovered 3.0 m barrel (G) Along the Break In Slope Just Above the Thalweg South of the Mouth of Redwood Creek, Let Down Slowly, Shells at the Bottom, Shells at the Top, South San Francisco Bay, Between the San Mateo and Dumbarton Bridge
90-25	19900300000006	37.52867	-122.16500	j190sf	gravity core	4.7	6-g-25	25 Recovered 2.5 m barrel (G) South of the Mouth of Redwood Creek In Line With #24 In 4.7 M of Water, South of # 26, Two Attempts, Shell On Bottom: Slightly Sandy Silt, Top: Shells, South San Francisco Bay, Between the San Mateo and Dumbarton Bridge
90-26	19900300000007	37.53050	-122.16783	j190sf	gravity core	6.0	7-g-25	26 Recovered 2.5 m barrel (G) South of the Mouth of Redwood Creek North of #25 Along the Channel Slope, Free Fall, Sandy Silt, Top: Worm Tubes, Shells, South San Francisco Bay, Between the San Mateo and Dumbarton Bridge
90-27	19900300000008	37.53267	-122.17017	j190sf	gravity core	7.5	8-g-25	27 Recovered 2.5 m barrel (G) South of the Mouth of Redwood Creek North of #26 Along the Channel Slope In Deeper Water, Free Fall, Bottom: Firm Mud, Top: Small Shell Fragments Worm Tubes, Sand, South San Francisco Bay, Between the San Mateo and Dumbarton Bridge
90-28	19900300000009	37.54117	-122.18633	j190sf	gravity core	3.3	9-g-25	28 Recovered 3.0 m barrel (G) Adjacent to the Mouth of Redwood Creek South of the Shoals, Bottom - Shells Top: Shells, South San Francisco Bay, Between the San Mateo and Dumbarton Bridge
90-29	19900300000010	37.54450	-122.18583	j190sf	gravity core	6.1	10-g-25	29 Recovered 3.0 m barrel (G) Down Slope of #28 Near the Redwood Creek Mouth Shoals, Bottom: Stiff Mud, No Shells, Top: Firm Mud, Shells, South San Francisco Bay, Between the San Mateo and Dumbarton Bridge
90-30	19900300000011	37.54433	-122.19017	j190sf	gravity core	3.9	11-g-25	30 Recovered 3.0 m barrel (G) On Top of the Redwood Creek Mouth Shoals South of the Mouth, Buried Head, Bottom: Firm Mud, Top: Mud, Shells, South San Francisco Bay, Between the San Mateo and Dumbarton Bridge

Sample Id	Navigation Time[1]	Latitude	Longitude	Activity ID (cruise)	Collection Device	Depth (m)	Original Sample Id	Sample Collection Comments
90-31	19900300000012	37.54617	-122.19000	j190sf	gravity core	11.2	12-g-25	31 Recovered 3.0 m barrel (G) Down Slope of #30 South of the Mouth of Redwood Crk, Bottom: Firm Mud, Top: Firm Mud, Shells, South San Francisco Bay, Between the San Mateo and Dumbarton Bridge
90-32	19900300000013	37.54117	-122.18083	j190sf	gravity core	12.5	13-g-25	32 Recovered 3.0 m barrel (G) South of the Mouth of Redwood Crk, South of #28 Near the Thalweg, Problems: Short Take, Bottom: Clay With Shell Material, Top: Worms, Shell, Not Sure Core Went In Vertically, South San Francisco Bay, Between the San Mateo and Dumbarton Bridge
90-34	19900300000015	37.55517	-122.17833	j190sf	gravity core	9.2	1-g-26	34 Recovered 2.5 m barrel (G) Along Northeast Side of the Main Channel On the Slope of the Channel In Line With #30,31, &33, Bottom: Cohesive Stiff Clay Mud Top: Shell Hash, Worm Tubes, South San Francisco Bay, Between the San Mateo and Dumbarton Bridge
90-35	19900300000016	37.54650	-122.18450	j190sf	gravity core	10.5	2-g-26	35 Recovered 2.5 m barrel (G) Near the Thalweg of the Main Channel In-Line With #28, & 29., Lost About 20 Cm of Bottom of the Core: Cohesive Mud, Top: some Shelly Material, South San Francisco Bay, Between the San Mateo and Dumbarton Bridge
90-36	19900300000017	37.55017	-122.18033	j190sf	gravity core	14.0	3-g-26	36 Recovered 3.0 m barrel (G) Near the Thalweg Along Northeast Side of the Channel In-Line With #35, Free Fall, Bottom: Sand Fairly Well Sorted, South San Francisco Bay, Between the San Mateo and Dumbarton Bridge
90-37	19900300000018	37.55350	-122.18217	j190sf	gravity core	10.5	4-g-26	37 Recovered 3.0 m barrel (G) Upslope and North of #36, Free Fall, Bottom: Shelly Mud, Top: Silt? With some Shell Fragments, South San Francisco Bay, Between the San Mateo and Dumbarton Bridge
90-38	19900300000019	37.55850	-122.17733	j190sf	gravity core	5.5	5-g-26	38 Recovered 3.0 m barrel (G) Near the Top of the Northeast Channel Margin Upslope of #34, Free Fall, Bottom: Mud, some Shells, South San Francisco Bay, Between the San Mateo and Dumbarton Bridge

Sample Id	Navigation Time[1]	Latitude	Longitude	Activity ID (cruise)	Collection Device	Depth (m)	Original Sample Id	Sample Collection Comments
90-142	19900430000001	37.56717	-122.23500	j290sf	gravity core	3.0	021290-1	142 Recovered SFB021290-1 3.0 m barrel (G) Above Top of Bank ~ 1.2 mi S of San Mateo Bridge Shell On Top South San Francisco Bay South and Adjacent to the San Mateo Bridge
90-143	19900430000002	37.56867	-122.23383	j290sf	gravity core	0.0	021290-2	143 Recovered SFB021290-2 3.0 m barrel (G) Top of Bank Just Above Break In Slope Shell at Top and Bottom South San Francisco Bay South and Adjacent to the San Mateo Bridge
90-144	19900430000003	37.56850	-122.23050	j290sf	gravity core	6.7	021290-3	144 Recovered SFB021290-3 3.0 m barrel (G) Bank Slope Shell at Top and Bottom South San Francisco Bay South and Adjacent to the San Mateo Bridge
90-145	19900430000004	37.57067	-122.23267	j290sf	gravity core	10.5	021290-4	145 Recovered SFB021290-4 3.0 m barrel (G) Base of Slope South San Francisco Bay South and Adjacent to the San Mateo Bridge
90-146	19900430000005	37.57250	-122.22667	j290sf	gravity core	14.5	021290-5	146 Recovered SFB021290-5 3.0 m barrel (G) Mid Channel Shell at Surface Sand at Depth South San Francisco Bay South and Adjacent to the San Mateo Bridge
90-148	19900430000007	37.57450	-122.22150	j290sf	gravity core	5.8	021290-7	148 Recovered SFB021290-7 3.0 m barrel (G) Upper Mid-Bank Slope South San Francisco Bay South and Adjacent to the San Mateo Bridge
90-149	19900430000008	37.57583	-122.22100	j290sf	gravity core	16.0	021290-8	149 Recovered SFB021290-8 3.0 m barrel (G) Base of Slope Stiff Mud at Bottom South San Francisco Bay South and Adjacent to the San Mateo Bridge
90-150	19900430000009	37.57717	-122.22117	j290sf	gravity core	10.5	021290-9	150 Recovered SFB021290-9 3.0 m barrel (G) Lower Slope Bank Stiff Mud at Base South San Francisco Bay South and Adjacent to the San Mateo Bridge
90-151	19900430000010	37.58000	-122.19283	j290sf	gravity core	3.5	021290-10	151 Recovered SFB021290-10 3.0 m barrel (G) Shallow Subtidal Flats Se of San Mateo Bridge South San Francisco Bay South and Adjacent to the San Mateo Bridge
90-174	19900510000001	37.60250	-122.25850	j290sf	gravity core	4.5	022090-1	174 Recovered SFB022090-1 3.0 m barrel (G) Area On E. Side of Channel N. of San Mateo Bridge Up to South Hampton Shoal Bank Top, Flat Bottom Core Bottoms In Mixed Clean Sand, Mud Penetrates to Barrel Top South San Francisco Bay North of the San Mateo Bridge to Potrero Point and Alameda Outer Harbor

Sample Id	Navigation Time[1]	Latitude	Longitude	Activity ID (cruise)	Collection Device	Depth (m)	Original Sample Id	Sample Collection Comments
90-175	19900510000002	37.60017	-122.25950	j290sf	gravity core	5.0	022090-2	175 Recovered SFB022090-2 3.0 m barrel (G) In Topographically Irregular Area Hint of Shell Layer In Bottom South San Francisco Bay North of the San Mateo Bridge to Potrero Point and Alameda Outer Harbor
90-176	19900510000003	37.59833	-122.26133	j290sf	gravity core	10.0	022090-3	176 Recovered SFB022090-3 3.0 m barrel (G) Mid-Slope of Bank E. Side of Channel Stiff Green Clay at Base South San Francisco Bay North of the San Mateo Bridge to Potrero Point and Alameda Outer Harbor
90-177	19900510000004	37.59550	-122.26017	j290sf	gravity core	14.0	022090-4	177 Recovered SFB022090-4 3.0 m barrel (G) Lower Slope of E. Bank Green-Yellow Stiff Clay at Core Base, Shelly at Top. South San Francisco Bay North of the San Mateo Bridge to Potrero Point and Alameda Outer Harbor
90-178	19900510000005	37.59217	-122.26433	j290sf	gravity core	17.0	022090-5	178 Recovered SFB022090-5 3.0 m barrel (G) Channel Floor In Furrow Field Furrows Evident Good Stratification South San Francisco Bay North of the San Mateo Bridge to Potrero Point and Alameda Outer Harbor
90-179	19900510000006	37.60750	-122.25350	j290sf	gravity core	3.5	022090-6	179 Recovered SFB022090-6 3.0 m barrel (G) Above Abrupt Scarp (Dredge) N. of Bridge Lots of Shells On Anchor South San Francisco Bay North of the San Mateo Bridge to Potrero Point and Alameda Outer Harbor
90-180	19900510000007	37.60617	-122.25567	j290sf	gravity core	0.0	022090-7	180 Recovered SFB022090-7 3.0 m barrel (G) Below Break In Slope Buried 3.0 m barrel (G) and Head, Bag the Material From the Core Cutter.? South San Francisco Bay North of the San Mateo Bridge to Potrero Point and Alameda outer Harbor
90-193	19900520000001	37.49600	-122.08817	j290sf	gravity core	5.0	022190-1m	193 Recovered SFB022190-1mh 1.75 m barrel (G) Slump Area Off Newark Slough., On Slope In Evacuated Zone of Slump Core for Geotechnical Analysis South San Francisco Bay North of the San Mateo Bridge to Potrero Point and Alameda Outer Harbor
90-195	19900520000003	37.49600	-122.08817	j290sf	gravity core	5.0	022190-1	195 Recovered SFB022190-1 3.0 m barrel (G) Free Fall In Same Area of Cores 192-193 Free Fall South San Francisco Bay North of the San Mateo Bridge to Potrero Point and Alameda Outer Harbor

Sample Id	Navigation Time[1]	Latitude	Longitude	Activity ID (cruise)	Collection Device	Depth (m)	Original Sample Id	Sample Collection Comments
90-197	19900520000005	37.49733	-122.09250	j290sf	gravity core	3.4	022190-2	197 Recovered SFB022190-2 2.5 m barrel (G) 3.25-3.50 M, Same Area As 195 South San Francisco Bay North of the San Mateo Bridge to Potrero Point and Alameda Outer Harbor
90-198	19900520000006	37.49733	-122.09567	j290sf	gravity core	7.5	022190-3m	198 Recovered SFB022190-3mh 2.5 m barrel (G) North Edge of Irregular Bottom, Down Slope From 194 and 195 In Slump Mass Core for Geotechnical Analysis Free Fall, Upper 1.5' Probably Disturbed South Sa N Francisco Bay North of the San Mateo Bridge to Potrero Point and Alameda Outer Harbor

[1]yyyydddhhmmsst format; yyyy, year; ddd, day of the year; hh, mm, ss, t is hour (out of 24), minute, second, and tenths of seconds, respectively. Sequential time assigned for each day of data collection as original collection times are not available.

Table A3. Inventory of physical materials and analyses.

Sample Id	Split Core Photos[a]	Handwritten Core Description[a]	X-Radiographs[b]	Grainsize Analyses[c]	Radiocarbon Dates[d]	Synthetic Core[e]	Graphic Log[f]
90-1	90-1	90-1	01-g-23				90-1.pdf
90-2		90-2	02-g-23				90-2.pdf
90-3		90-3	03-g-23a				90-3.pdf
90-4	90-4	90-4	04-g-23	90-4			90-4.pdf
90-5	90-5	90-5	05-g-23				90-5.pdf
90-6	90-6	90-6	06-g-23				90-6.pdf
90-7	90-7	90-7	07-g-23				90-7.pdf
90-8	90-8	90-8	01-g-24a	90-8			90-8.pdf
90-9	90-9	90-9	02-g-24a				90-9.pdf
90-10	90-10	90-10	03-g-24		90-10		90-10.pdf
90-12		90-12	05-g-24	90-12			90-12.pdf
90-13		90-13	06-g-24				90-13.pdf
90-19		90-19	12-g-24				90-19.pdf
90-20		90-20	01-g-25				90-20.pdf
90-21		90-21	02-g-25				90-21.pdf
90-22	90-22	90-22	03-g-25				90-22.pdf
90-23	90-23	90-23	04-g-25	90-23			90-23.pdf
90-24	90-24	90-24	05-g-25		90-24		90-24.pdf
90-25	90-25	90-25	06-g-25				90-25.pdf
90-26	90-26	90-26	07-g-25				90-26.pdf
90-27	90-27	90-27					90-27.pdf
90-28	90-28	90-28	09-g-25		90-28	90-28	90-28.pdf
90-29		90-29	10-g-25				90-29.pdf
90-30	90-30	90-30	11-g-25		90-30	90-30	90-30.pdf
90-31	90-31	90-31	12-g-25		90-31	90-31	90-31.pdf
90-32	90-32	90-32	13-g-25				90-32.pdf
90-34	90-34	90-34	01-g-26				90-34.pdf
90-35	90-35	90-35	02-g-26				90-35.pdf
90-36	90-36	90-36	03-g-26		90-36	90-36	90-36.pdf
90-37	90-37	90-37	04-g-26				90-37.pdf
90-38	90-38	90-38	05-g-26	90-38			90-38.pdf
90-142	90-142	90-142		90-142	90-142		90-142.pdf
90-143	90-143	90-143					90-143.pdf
90-144		90-144					90-144.pdf
90-145	90-145	90-145					90-145.pdf
90-146	90-146	90-146		90-146			90-146.pdf
90-148		90-148					90-148.pdf
90-149		90-149					90-149.pdf
90-150	90-150	90-150			90-150	90-150	90-150.pdf
90-151	90-151	90-151		90-151	90-151	90-151	90-151.pdf

Sample Id	Split Core Photos[a]	Handwritten Core Description[a]	X-Radiographs[b]	Grainsize Analyses[c]	Radiocarbon Dates[d]	Synthetic Core[e]	Graphic Log[f]
90-174	90-174	90-174					90-174.pdf
90-175	90-175	90-175					90-175.pdf
90-176	90-176	90-176					90-176.pdf
90-177	90-177	90-177			90-177	90-177	90-177.pdf
90-178	90-178	90-178		90-178	90-178	90-178	90-178.pdf
90-179	90-179	90-179					90-179.pdf
90-180	90-180	90-180		90-180			90-180.pdf
90-193		90-193					90-193.pdf
90-195		90-195					90-195.pdf
90-197		90-197					90-197.pdf
90-198	90-198	90-198					90-198.pdf

[a]Available at http://walrus.wr.usgs.gov/infobank/j/j190sf/html/j-1-90-sf.meta.html and http://walrus.wr.usgs.gov/infobank/j/j290sf/html/j-2-90-sf.meta.html under Samples > data

[b]Available at http://walrus.wr.usgs.gov/infobank/j/j190sf/html/j-1-90-sf.meta.html and http://walrus.wr.usgs.gov/infobank/j/j290sf/html/j-2-90-sf.meta.html under Imagery > data

[c]Available in appendix 1

[d]Available in table 1

[e]Available in appendix 2

[f]Available in appendix 3