Stratigraphy and Sedimentology of Sediments on the Northeastern Grand Banks of Newfoundland from Borehole Investigation

by

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Introduction

The Grand Bank borehole investigation programme has two major objectives: (1) to evaluate the geological aspects of engineering constraints to offshore development on a regional basis; and (2) to verify the present geological interpretations on the Grand Banks which have been previously based primarily on high resolution seismic reflection data. Within the Hibernia region, the Atlantic Geoscience Centre's (AGC) objectives are to determine the age, depositional environment and physical properties of the seismostratigraphic units (Fader and King, 1981; Lewis et al., 1987). Lewis et al. (in press) have interpreted the near-surface sediments in the region to be deltaic (up to 80 metres thick), possibly of late Tertiary to early Pleistocene age, though, to date, age control has been very limited. This sequence is overlain by a thin (1-10 m-thick) unit of recent reworked sand and gravel (Barrie, 1984).

In July and August of 1988, Petro-Canada Resources Ltd. drilled and sampled into near-surface sediments at their Terra Nova site on the Grand Banks for preliminary engineering studies (AGC cruise number 88400 [Moran and Mosher, 1988]). AGC requested participation in the programme in order to complete several boreholes and chose the Bowers Pit site for investigation as an optimum site to address both major objectives. In addition to the two boreholes drilled at, or near Bowers Pit (88400-06 and 07) AGC was given access to describe and subsample the boreholes collected by Petro-Canada at the Terra Nova site.

In August and September, 1988, Mobil Oil Canada Ltd. carried out an extensive borehole programme to investigate the geotechnical properties of the sediments underlying the site of their proposed Gravity Based Structure production platform (GBS) at Hibernia, on the Grand Banks of Newfoundland (AGC cruise number 88401). AGC jointly participated in their program by providing geophysical data over the site and by collaboration on the M/V Pholas drill ship. Onboard the ship, AGC conducted a geological research programme which included lithological description, photo-documentation, measurement of sediment acoustic compressional wave velocity, and subsampling for palaeomagnetic, X-radiographic, sedimentologic and biostratigraphic studies on all borehole samples. In addition to participation in Mobil's site investigation, AGC bought one additional drilling day in order to perform cone penetration tests at the Bowers Pit site (Moran et al., 1988).

Bowers Pit site is the location of a 10 m deep iceberg impact pit. The pit is within sediment

immediately overlying the seismically identified delta sequence (Lewis et al., in press). During cruise 88400, this site was drilled and discontinuously sampled to 84 metres below seafloor (mbsf). Several major regional seismic reflectors were intersected (Moran and Mosher,1988). During 88401 a 106 m cone penetrometer test, penetrating through the delta sediment, was completed. This data can assist in continuous stratigraphic interpretation.

Through the course of the two drilling programmes, 32 boreholes were completed, resulting in a total of 889 m drilled. The deepest hole is just over 100 m at the GBS site. Table 1 gives the location and total depth of penetration of each of the boreholes. It is the purpose of this report to study and report on the geology of the borehole sediments, through sedimentologic facies analysis and to collect and submit subsamples for further analyses that will enhance our knowledge of the geology and physical properties of these sediments.

NOTE: Appendices B through D and the associated photographs and video are archived at the Atlantic Geoscience Centre Curation in Dartmouth, N.S with the original contract report. They are not included with this Open File for ease in distribution and pricing. They are available for viewing or for copying at AGC Curation.

Background:

A number of previous industry boreholes have been drilled on the Grand Banks as part of site investigations and pipeline route surveys (Barrie et al., 1984; Collins and Christian, 1984; Geocon, 1980a, b, and c), and an abundance of both industry and government high resolution seismic reflection data have been collected from the area including lines that tie together the borehole sites (King, 1989; Douma. 1989; Parrott et al., 1989; Lewis et al., in press).

Previous Boreholes:

Mobil Oil Canada Ltd. retained Geocon Offshore Ltd. in 1980 to conduct marine geotechnical investigations at the Hibernia O-35, B-08, and Ben Nevis I-45 exploration well sites on the Grand Banks of Newfoundland (Geocon, 1980a, b, and c) (Figure 1). The study was carried out to provide geotechnical information for the evaluation of proposed well-head protection measures. Some grain size data and physical property data exists in the Geocon reports. At the I-45 site Geocon (1980a) describe washed granular material to about 2 m, underlain by dense clean sand to silty sand from about 2 to 5.5 m. A stratum of clayey silt to sand with shells from 5.5 to 8.7 m was encountered. From 8.7 - 16 m they describe strata of sand with some silt and clayey silt with sand. This interval is underlain by silty clay to about 47.5 m. This clay is underlain by

sand with silt to the base of the borehole at 51 m.

At the O-35 site Geocon (1980b) describe the presence of a washed sand and gravel unit to a subsurface depth of about 3 m. Between 3 and 55 m they report the presence of extensive fine sand with silt, with occasional clayey zones or layers. This interval is underlain by a deposit of silty clay to 57.6 m. The borehole was terminated in silty sand with clay at 58.5 m.

The sediments described from the B-08 site are similar to those from the O-35 site (Geocon, 1980c). Geocon (1980c) observed the washed sand and gravel unit to 6.7 m, underlain by silty sand with some clay to 8.8 m. The underlying deposits consist of alternate layers of silty sand and silty clay, some 1.5-3 m in thickness, to 10.7 m below seafloor. Below 10.7 m Geocon (1980c) describe an extensive layer of sand with some silt to a subbottom depth of 45 m. The sandy deposit is underlain by silty clay to 49 m, which in turn is underlain by an interval of silty sand with clay layers to 59 m.

In 1983 Mobil Oil Canada Ltd. conducted a geotechnical borehole investigation programme on the Grand Banks of Newfoundland in support of its plans to develop the Hibernia oil discovery (Barrie et al., 1984). A total of 28 borings were completed from the drill ship M/V Pholas. On the northeastern Grand Banks, the most significant boreholes in terms of this study, i.e. the deepest holes with best sample recovery, were E-1A, C-1A and W-1 (Table 1, Figure 1).

Barrie et al. (1984) divided the sedimentary sequence recovered in these boreholes into three stratigraphic units: 1) a surficial unit (Unit 1) which varies between 0.5 and 3.0 m thick and is composed of clean sand and gravel with abundant shell hash material. They suggest that this unit represents the Quaternary section unconformably overlying Tertiary deposits. 2) In Unit 2 the soil strength increases significantly. The unit is represented by several lithified siltstones to very fine sandstone layers at the very top, to medium and coarse, olive-grey dense sands for the remainder of the unit. The thickness of Unit 2 increases from 50 m in the west to 85 m in the east. Barrie et al. (1984) assign this unit to the Tertiary (Pliocene to Miocene) Banquereau formation (Jansa and Wade, 1974). 3) Unit 3 is composed of stiff dark-grey clay and silt. All boreholes were terminated in this unit and the actually contact between this unit and Unit 2 were not observed.

Collins and Christian (1984) participated in a Petro-Canada borehole programme at the Terra Nova K-18 site from the drill rig Sedco 710 (Figure 1). They describe similar sediments to Barrie et al., without the unit designations and a slightly different stratigraphic succession: from 0-5 m, poorly sorted sand and gravel with abundant shell fragments; from 5-8 m well sorted olive grey fine sand to silt with no shells; from 8 m to the base of the borehole(100 m), layers of dk grey fine sand/silt interbedded with units of clay. Shells and gravel were rare in this lowermost interval.

Table 1: Core Locations

Borehole No.	Latitude	Longitude	Water Depth (m)	Total Penetration (m)	No. of Samples
88400-01:Terra Nova	46° 27.12'	-48° 29.67'	93.7	51.46 31	
88400-02:Terra Nova	46° 28.01'	-48° 24.97'	96.9	51.11	26
88400-03:Terra Nova	46° 26.50'	-48° 26.99'	96.4	24.36	17
88400-04:Terra Nova	46° 28.51'	-48° 28.51'	94.6	24.30	18
88400-05:Terra Nova	46° 27.40'	-48° 31.00'	93.4	16.23	13
88400-06:Bowers Pit	46° 43.24'	-48° 37.57'	97.2	86.2	54
88400-07:Bowers Pit	46° 43.61'	-48° 37.5'	90.3	16.18	13
88400-08:Bowers Pit	46° 43.79'	-48° 37.32'	91.44	2.13	1
88401-G1A:GBS	46°45.833'	-48°45.582'	79.43	118.9	36
88401-G2:GBS	46°45.829'	-48°45.582'	79.25	2.32	2
88401-G2A:GBS	46°45.831'	-48°45.583'	79.34	48.96	11
88401- G3:GBS	46°45.828'	-48°45.587'	79.26	6.00	2
88401- G4:GBS	46°45.838'	-48°45.566'	79.14	9.00	3
88401- G5:GBS	46°45.817'	-48°45.584'	79.42	3.00	1
88401- G6:GBS	46°45.840'	-48°45.601'	79.07	9.00	3
88401- G7:GBS	46°45.860'	-48°45.582'	78.94	36.00	9
88401- G8:GBS	46°45.821'	-48°45.549'	79.62	46.80	35
88401- G9:GBS	46°45.83'	-48°45.61'		48.00	15
88401- G10:GBS	46°45.851'	-48°45.541'		8.70	3
88401- G11:GBS	46°45.81'	-48°45.58'		12.30	6
88401- G12:GBS	46°45.86'	-48°45.62'		3.80	2
88401- G12A:GBS	46°45.86'	-48°45.62'		5.00	3
88401- G13:GBS	46°45.83'	-48°45.55'		0.07	1
88401- G14:GBS	46°45.86'	-48°45.57'	80.28	16.00	7
88401- G15:GBS	46°45.82'	-48°45.58'	80.13	13.00	5
88401- NEA1:GBS	46°46.61'	-48°44.46'	83.88	35.00	10
88401- NEA2:GBS	46°46.61'	-48°44.47'		13.00	8
88401- NEA3:GBS	46°47.20'	-49°19.81'	83.58	12.00	4
88401- SEA1:GBS	46°45.08'	-48°44.46'	83.98	15.52	5
88401- SEA2:GBS	46°45.07'	-48°44.48'	82.78	39.00	18
88401- SEA3:GBS	46°45.09'	-48°44.47'	82.78	27.52	12
88401- 022:	46°45.830'	-48°45.580'	109.43	87.92	1
Hibernia B-08	46°47.08'	-48°45.51'	79.5	59.13	
Hibernia O-35	46°44.93'	-48 49.85'	79.5	58.52	
Ben Nevis I-45	46°34.60'	-48°21.25'	101.19	50.90	
Terra Nova K-18	46°27.50'	-48°30.99'	89.85	100.36	50
Pholas E-1A	46°46.03'	-48°45.87'		100.61	60
Pholas C-1A	46°44.97'	-48°47.72'		99.49	88
Pholas W-1	46°44.80'	-48.49.63'		130.56	70

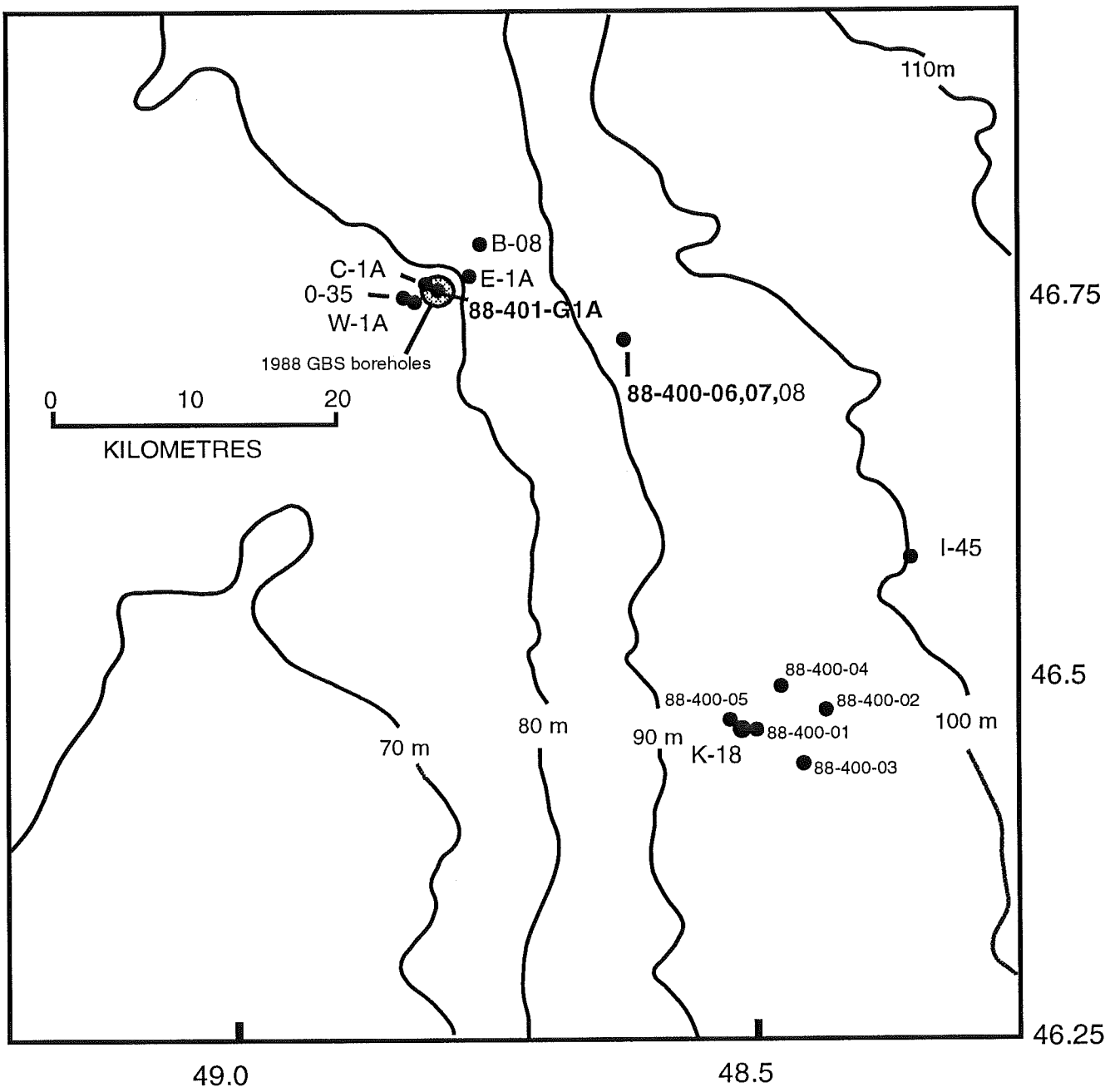

Figure 1: Boreholes collected prior to 1988 in the Jeanne d'Arc Basin and described in this report.

Seismic stratigraphy :

An abundance of industry and Government seismic reflection data have been collected on the northeastern Grand Banks of Newfoundland. The high resolution records required to correlate with borehole information include Huntec DTS boomer, Sparker, and 40 cu.in. air gun sources. These data have been recently compiled by Douma (1989). It is necessary to briefly review the seismic reflection character/stratigraphy of the area to correlate between boreholes and to interpret the sedimentologic sequences found in the boreholes.

Lewis et al. (in press) interpret the seismostratigraphy of the area from some of the best high resolution data available from the area. Seismic reflectors from the shallow subsurface (from near the seafloor to at least several hundred metres below the seafloor) of the northeastern Grand Banks are generally parallel, continuous horizons that are correlatable over 10's of kilometres. Variation in wavelet amplitudes and lateral pinchout make correlations of individual horizons over larger areas difficult. These reflectors are slightly dipping (e.g. average of 0.1°, ranging from 0.05° to 0.22°) to the east-northeast and strike about 150°. A wedge-shaped seismic unit with internal clinoform-shaped reflectors, dipping to the ENE is evident within the top 100 m of the sediment column, overlying the Hibernia Oilfield. Boreholes C-1A, E-1A, W-1, B-08, O-35, and the recently collected 88400-06 and all of the 88401 boreholes are located within this clinoform sequence. Lewis et al. (in press) interpret this units as a marginal marine delta. Seaward, the seismic stratigraphy at the Terra Nova site is one of the continuous, slightly dipping, parallel reflectors interpreted as distal prodelta by Lewis et al. (in press). The remainder of the 88400 boreholes are located at this site.

RESULTS

1) Core photographs:

Core photographs were analyzed and compared with sample descriptions. Photos were laid out in stratigraphic context to study general stratigraphic trends. Contact prints of Photos from boreholes 88400-01, 06, and 88401-G1/G1A were laid out in stratigraphic order and are available for viewing at the Atlantic Geoscience Centre Curation Section in Dartmouth, N.S.

2) X-radiographs:

All whole and half core samples brought back to Bedford Institute from the borehole programmes were analyzed with video X-radiography. The samples were analyzed and some sample photographs are included in Appendix "B", which is also available at AGC Curation along with a videotape of the entire collection.

3) Lithologic columns and facies descriptions:

Based on sample descriptions, and the results from the photo and X-radiographic analyses 5 lithofacies have been defined. Lithologic columns of 88400-01, -06, -07, 88401-G1/G1A and previously collected boreholes (E1-A, C1-A, W1-A, I-45, K-18, and B-08) have been compiled using these facies descriptions (Figure 2). Since detailed work on 88400-01, 06, 07 and 88401-G1/G1A was necessary, large scale graphic columns have been compiled for these boreholes only. These columns show observed sediment types and structures, thus gross categorization into facies is avoided. These figures are included in Appendix A.

4) Sample recovery, sample descriptions and subsample information

Included in Appendix "A" are tables of the sample recovery, and the visual descriptions of each sample collected, and subsamples taken from each sample at the time of first description, usually on board ship. The sample descriptions are the initial shipboard descriptions, or in the case of 88400-06, are the descriptions of the sediment upon extrusion from the shelby tube, in the AGC core lab and do not include X-radiographic or grain size analysis information.

5) Grain size analyses:

77 samples from 88400-06 were analyzed for gravel/sand/silt/clay ratios by AGC sedimentation lab. 65 of these samples were further analyzed for full size distribution of the >53 μm fraction of 2 phi intervals by the AGC sedimentation lab. 15 sample from 88400-07 were analyzed for gravel/sand/silt/clay ratios. 22 samples from 88401 -G1/G1A were also analyzed for ratios and full size distribution of the >53 μm fraction of 2 phi intervals. All size analyses data and histograms of distributions are included in Appendix "C"(available for viewing at the Atlantic Geoscience Centre Curation Section in Dartmouth, N.S.), as are a record of samples submitted. Dips in the distribution curves at 1 phi are not real but are a function of the cut-off size used in sample preparation.

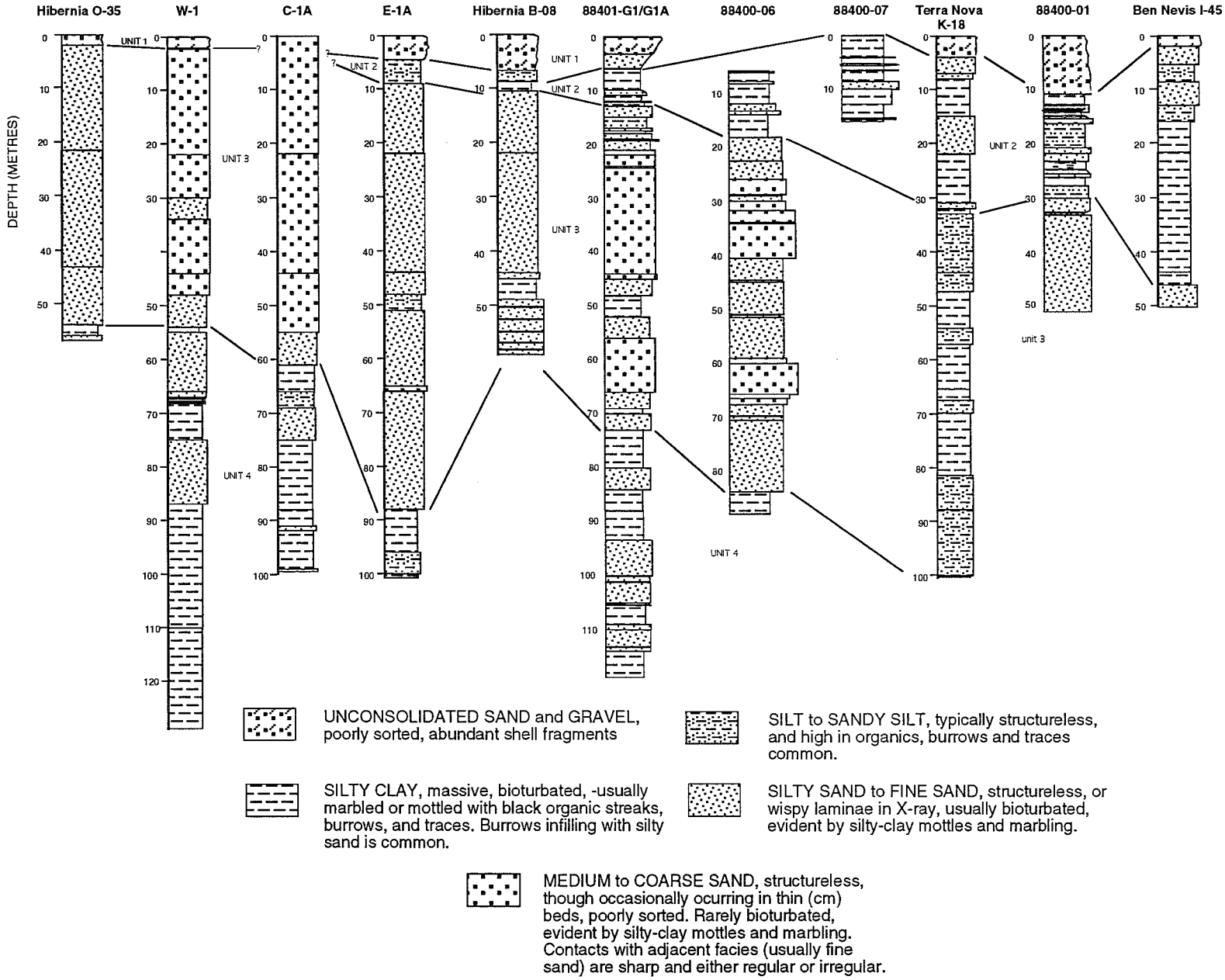

Figure 2: Lithologic columns showing five lithofacies, defined based on sample descriptions, and photo and X-radiographic analyses. Four units are recognized: Unit 1- unconsolidated sand and gravel with abundant shell hash; Unit 2- interbedded sandy silt and silty clay; Unit 3- sand-dominated, with several coarse sand intervals; Unit 4- interbedded clay, silty clay, and silty sands, very stiff to hard.

6) Organic carbon content:

4 samples from 88401-G1/G1A were submitted for total carbon and organic carbon content to test the suggestion that the black material in the cores and the smell of H_2S are organic in origin. The results are included in this report.

7) Physical property information has been compiled and is included in Appendix "D" (available for viewing at the Atlantic Geoscience Centre Curation Section in Dartmouth, N.S.). The data includes bulk density, water content, velocity and cone penetrometer (friction, cone bearing and pore pressure) measurements.

8) Further sample submissions

Samples were collected and submitted for palynological analyses, and paleomagnetic testing.

9) Report:

This report contains the results of this contract and analyses that have been completed. These results are discussed in context with core correlations and the seismostratigraphy established for the area (Lewis et al., in press), with study of sedimentary processes as the main objective. Summary figures and a discussion section have been prepared for this purpose.

Results

Due to the large number of boreholes collected it was impossible to analyze each sample; therefore, five boreholes were chosen to conduct detailed sedimentologic work: boreholes 88400-06, and 07 in the Bowers Pit area, 88401-G1 and G1A in the GBS area, and 88400-01 in the Terra Nova block. These specific boreholes were chosen on the basis of sample recovery and depth of penetration. A representative borehole of each of the three areas was chosen. Other boreholes are described with graphic columns of facies distribution only and are fitted into the stratigraphic context through core correlation.

Lithologic description

Visual lithologic descriptions of the borehole samples have proven to be the most useful tool for sedimentologic assessment. Further analyses, such as X-radiography and grain size tend to support and quantify visual observations.

Descriptions of the sediment collected range from silty clay, through to coarse sand, though gravel is observed in the surface samples (< 15 m), and, rarely, gravel is observed at depth within the coarser sand. On the whole, the borehole sediment appears to be highly bioturbated, though less so in the coarse sand units. Bioturbation is inferred from the mottled texture of the sediment (clay mottles and marbling in the sands, and sand lenses, pockets and patches in the silty clay). Colour marbling, normally of streaks, whirls and patches of black, presumably organic-derived, authigenic pyrite, is also prevalent and indicative of bioturbation. Occasional whole burrows, with backfill structures, are observed. It is significant to note that a distinct H_2S odour was noted in borehole G1A samples from about 70 m down to the end of the borehole, possibly indicative of high organic content.

In general, visual lithologic descriptions at the GBS and Bowers pit sites show unconsolidated sand and gravel over the top few metres, followed by silty clay to about 15 to 20 m. Interbedded fine, medium and coarse sand, and silty clay beds underlay this section, to about 80 m. Below this depth the boreholes show interbedded fine sand, and hard to very hard silty clay or clay. The sediment at the Terra Nova block is typically finer in nature, though the top few metres are similarly described as loose pebbly coarse sand. Underlying this section are interbedded silty clays, silty sands, and from about 30 m to the base of the boreholes at about 50 m, are predominantly very fine to fine sands.

X-radiographic descriptions

X-radiographic analysis were conducted with the AGC X-radiography/video facility. The analyses were conducted on whole and split samples that were preserved in cold storage. These samples are archived with the AGC core curation section and undisturbed as much possible.

The results of this analysis have shown the samples to be remarkably barren of sedimentary structures, though abundant bioturbation structures, such as burrows and traces, were observed. X-radiography was also able to distinguish between dominant grain size (i.e. coarse sand, fine sand, silt clay). Occasional bedding and contact surfaces were observed as well. X-radiography also easily distinguished between cuttings and sample. Examples of the results of this analysis are

displayed as polaroid prints and negatives in Appendix C, and the complete data set, with narration, is on video tape. Appendix C and the video are available for viewing at the Atlantic Geoscience Centre Curation Section in Dartmouth, N.S.

Four types of sediment could be distinguished using X-radiography, based on texture and structures within the sediment (Figure 3a-d): 1) Coarse sand, usually structureless, but occasionally occurring in thin beds. 2) Medium sand, usually structureless and thickly-bedded . 3) Fine sand, with common bioturbation trails throughout . The trails are narrow, long, swirled features which appear to have no preferred orientation . 4) Silt and clay sediments, which have a mottled appearance in X-ray (i.e. lighter and darker zones representing density variations). Occasionally burrows can be seen looking down the centre of a burrow giving a spiralled appearance (Figure3e).

It must be noted that X-radiography distinguishes drill cutting intervals very readily; recognizable by their blocky, fractured appearance, with large spaces between the blocks (Figure 3f).

Grain Size Analyses

Grain size analyses were conducted at the Atlantic Geoscience Centre sedimentation laboratory. Gravel:sand:silt:clay ratios are available from boreholes 88400-06 and 07. Due to the nature of the sediments within the boreholes it was felt that it would be most useful to have full size distribution data on the coarser than 53 μm fraction (sand and gravel). In this way coarsest percentile, mean and standard deviation data could be acquired, and assist in environment of deposition interpretations, as well as calibration of the cone data and characterization of the facies described. Full size distribution on the sand fractions from borehole 06 are available and presented in this report. These data are summarized in Figure 4, with distribution histograms of each of the samples analyzed in Appendix "C" (available for viewing at the Atlantic Geoscience Centre Curation Section in Dartmouth, N.S.).

The grain size ratio data essentially confirm visual descriptions of the borehole samples. Above and below the zone of clinoform reflections (henceforth termed the "delta") the data show equal proportions of abundant silt and clay (i.e. 40-45 % each). The most striking result is the abundance of sand within the "delta" (70-90%), with little gravel, and equal proportions of silt and clay (about 5-10 % each). The size distribution data support the visual descriptions of the grain size of the samples. Distribution of the sediment and accompanying statistics strongly show the distinction between the sediment overlying the delta unit, the delta unit itself, and the underlying

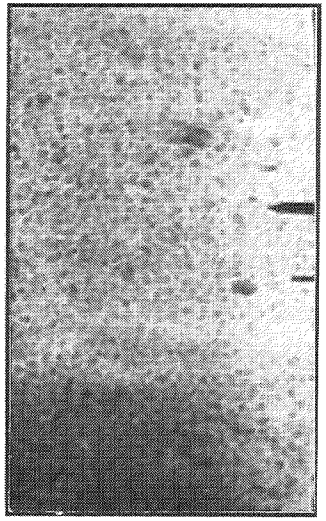

Fig.3a: Med to COARSE SAND, usually structureless, occasionally in thin beds

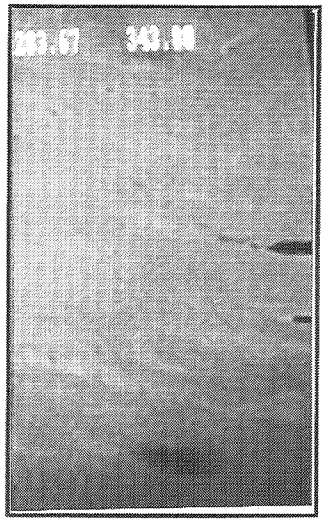

Fig.3b: MEDIUM SAND, usually structureless and thick-bedded.

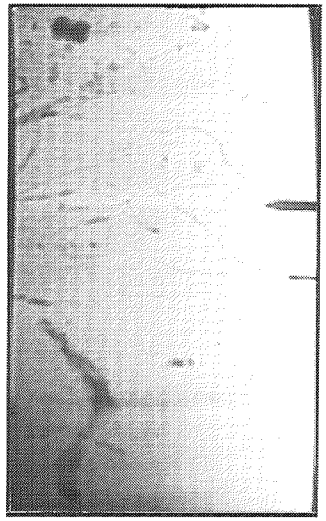

Fig.3c: FINE SAND, common bioturbation trails throughout.

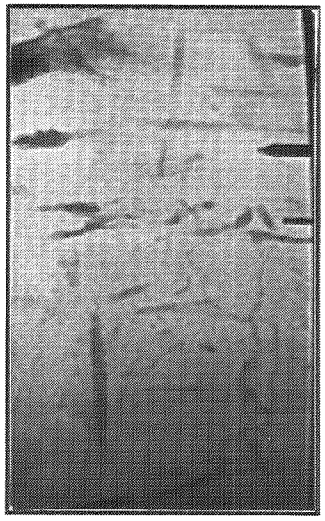

Fig.3d: Mottled SILT and CLAYwith bioturbation trails throughout.

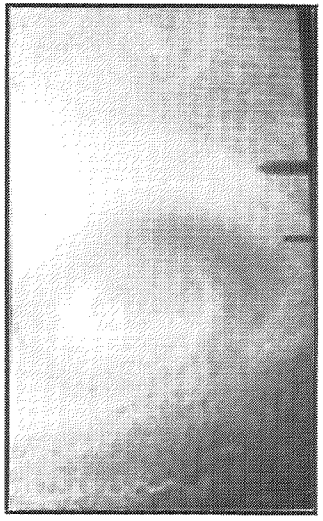

Fig.3e: view though the centre of a burrow giving a spiral appearance.

Fig.3f: Drill cuttings, distinguished by their blocky, fractured appearance.

Figure 3: X-radiographs illustrating sediment types and structures typical of the borehole sediments.

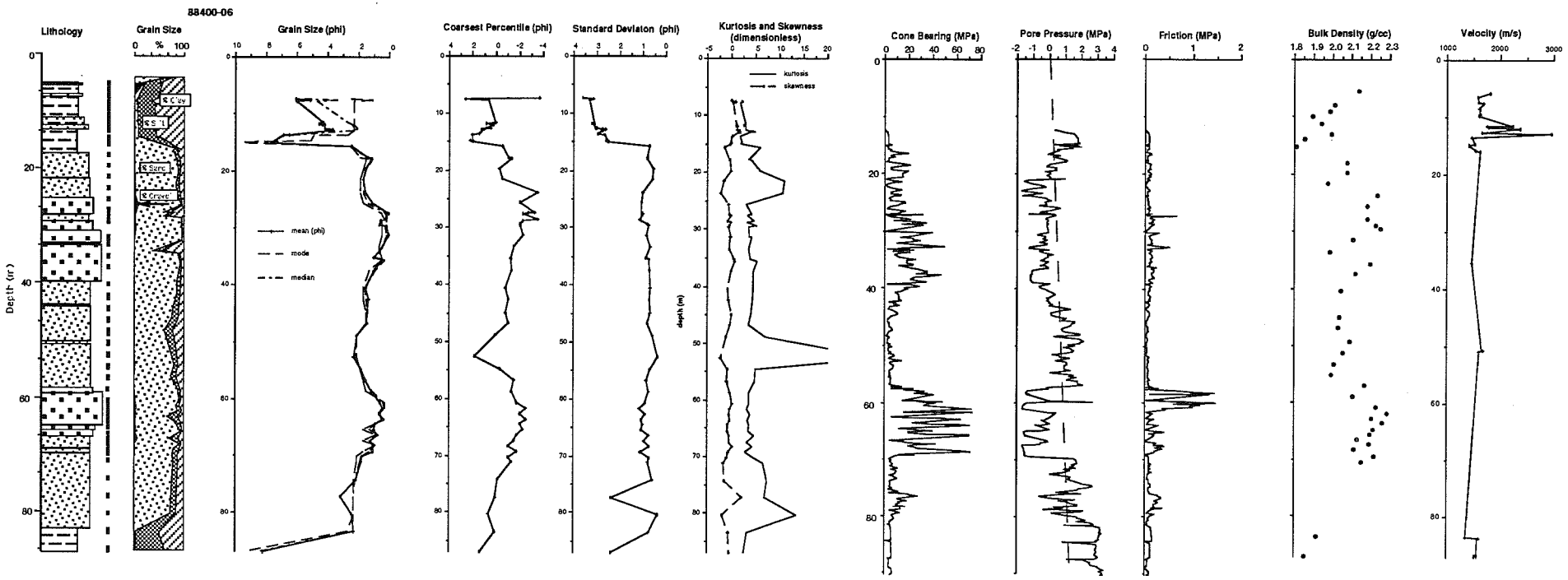

Figure 4: Summary diagram showing results of grainsize analyses, cone penetrometer, and physical property measurements.

sediments.

The uppermost unit shows large variability in the mean, median and modal sizes, with large separation between these measures within one sample. The standard deviation, which is a measure of sorting, is large (2.5 - 4.5), indicating the unit is poorly to extremely poorly sorted. The samples from this unit are mostly positively skewed and platykurtic.

Within the delta unit, the mean, median and modal sizes are very similar, indicating a nearly normal distribution of grain sizes. Within the delta sequence there are apparently two coarser intervals at about 25 - 35 m and between 55 and 70 m. In general the mean size increases and decreases gradually to these coarser intervals, i.e. they are not isolated spikes. On a finer scale subtle variations of the distribution data show the interbedded nature of the sediments in the delta unit . The standard deviation is generally about 1 in the coarser sand intervals (medium to coarse sands), thus the sediment is moderately sorted, while in the finer sands the standard deviation is about .4 to .7, thus is well-sorted. The distribution curves are typically symmetrical to slightly negatively skewed and meso-to leptokurtic. If the finer than 53 μm fraction were added to the distribution curve the skewness would be positive.

Grain size data from the unit below the delta sands is limited as borehole 88400-06 did not penetrate much below the delta. Apparently the mean size is much finer than within the delta, but not enough data exists to discuss general trends in the distribution data.

Organic Carbon Content

A number of subsamples were acquired during the recovery of the boreholes to analyze the samples for organic carbon content. Many of the black mottles, swirls and traces are believed to be the result of decayed organic material. Further recrystallization of this material, resulting in pyrite crystals, were also observed deep in borehole 88401-G1A. Many of the samples with these black mottles also exuded a strong odour of H_2S gas. Four samples were analyzed in a Leco Carbon Analyzer by the incineration method. The tests were duplicated and showed little variation between runs. The result are shown in Table 2.

Table 2: Carbon content

Borehole No.	Sample No.	Depth (m)	Organic Carbon (%)	Total Carbon (%)
88401-G1A	14	70.4-70.74	0.12	0.07
88401-G1A	16	73.0-73.18	0.26	0.28
88401-G1A	19	80.22-80.24	0.19	0.16
88401-G1A	34	113.3-113.4	0.51	0.42

Radiocarbon Dating

Two shell samples were submitted for AMS radiocarbon dating. The results are as follows.

Borehole	Sample No.	depth (m)	Beta Lab No.	Age (ybp)
88400-01	11	11.13	31727	8,890 ± 95
88400-04	14	14.47	31728	29,350 ± 440

Lithofacies descriptions

Five lithofacies have been identified from study of the borehole samples, based primarily on visual description, supported with X-radiographic descriptions, and grain size analyses. As further data becomes available it will be possible to add to these descriptions, or to further classify the samples.

1) **Unconsolidated sand and gravel:**

This facies consists of unconsolidated, or loose, sand and gravel, poorly sorted, with abundant shell fragments. It is typical of the surface sediment on the Grand Banks (Grand Banks Sand and Gravel formation or Adolphus Sand and Gravel Formation, Fader et al., 1985) and is seen in the top of most of the boreholes. This sediment type was normally collected with the split-spoon sampler. This facies also appears at several horizons in the 88401 boreholes, but its occurrence is highly suspect as cavings, due to the well-washed nature of the gravel and the poor preservation state of the shell material.

2) **Silty clay:**

Grain size analysis show that clay and silt are split in almost equal percentages in all of the samples analyzed, thus this facies can be described as silty clay or clayey silt. It is typically massive and heavily bioturbated, with evidence of marbles or mottles of black organic streaks, burrows and traces. Burrow infilling creating patches of silty sand is common. In boreholes from the GBS and Bowers Pit area this facies dominates in the top 15 to 20 m and again below about 80 m. It occurs throughout the boreholes from the Terra Nova area. It can be classified in terms of soil properties as stiff to very hard, the harder material being the deepest (i.e. below 80 m).

3) **Silt to Sandy silt:**

This facies is composed of well-sorted fine sand to coarse silt. It appears to be generally high in organic material, with common burrow and trace structures. Some occurrences of this

facies are described as organic silt. It is most commonly associated with the silty clay facies and occurs in the top 15–20 m and below 80 m at the Bowers Pit and GBS sites. It occurs throughout boreholes from the Terra Nova block .

4) **Silty sand to fine Sand:**

This facies is composed of well-sorted fine sand. It is common throughout the Bowers Pit and GBS, and the Terra Nova boreholes. It is typically massive, though in X-radiographs rare wispy laminae are observed (Figure 3). It is usually bioturbated with silty clay mottles and marbling, containing black organic streaks. Occasional clean, well sorted, unbioturbated fine sand beds are observed. Within the Bowers Pit Borehole (88400-06) it is most abundant in the uppermost and lowermost sections of the Hibernia delta.

5) **Medium to coarse Sand:**

This facies is dominant between about 20 and 65 m in the boreholes from the GBS and Bowers Pit area, and is absent from samples in the Terra Nova block. It is structureless and occurs in beds on the order of metres to tens of metres thick, though occasional thin (cm) beds have been observed. It is typically poorly sorted, containing grain sizes from clay through to gravel with the mean typically about medium sand. The gravel is usually fine and classified as granules. It is not heavily bioturbated, evident from rare silty clay mottles and marbling. Contacts with adjacent facies (usually fine sand) are sharp and either even or irregular.

Discussion

Lithostratigraphic columns of each of the studied boreholes and the older boreholes are presented in Figure 2. The 5 lithofacies facies can be grouped into 4 units.

1) A top-most unconsolidated sand and gravel (several m thick) unit with abundant shell hash.

2) A unit of interbedded sandy silt and silty clay.

3) A unit dominated by sand. Proximally (i.e. within the clinoform reflections) (e.g. 88400-06, 88401-G1A, W-1A, C-1A, B-08, I-45) this unit contains a high percentage of sand with several zones of coarse sand. Distal to the clinoform reflection sequence (i.e. Terra Nova (e.g. 88400-01, O-35, K-18) it is composed of silty sand to fine sand.

4) A lowermost unit of interbedded clay, silty clay, and silty sands or very fine sands. The clays tend to be very stiff to hard.

Unit 1 is the topmost unit believed to be representative of the Grand Banks Sand and Gravel Formation, or the Adolphus Sand and Gravel Formation described by Fader et al. (1985). It is variable in thickness from site to site, which is expected from the descriptions of these formations. Unit 3, at the Bowers Pit and GBS sites correlate with the seismostratigraphic unit of clinoform reflections (Lewis et al., in press). Based on the character of these reflections it has been interpreted as a delta. The borehole sediments confirm that it is likely a delta. The high percentage of sand with a significant fraction of finer sediment still apparent (i.e. positively skewed) is typical of fluvial deltaic environments (Folk, 1974). Due to the finer nature of the sediments within this unit at the Terra Nova site, and the lack of clinoform reflections in this area, the unit is felt to represent a distal environment of this delta sequence (prodelta). Units 2 and 4, sequences of finer, interbedded lithologies correlate with the parallel, slightly dipping reflections in the seismic records. These units are interpreted as prograding sequences and may represent a distal prodelta environment.

The results of carbon content analyses show a relatively high organic carbon content (0.12 - 0.5 %) in the samples tested in relation to other marine sediments (Rashid, 1984). These results confirm that the presence of black material appearing as specs, mottles, and swirls in the samples, and the occurrence of the H_2S odour are related to high organic carbon content. The fact that these sediments are high in organic carbon content further supports the interpretation that the sediments are part of a delta sequence. Whether the organics are marine or terrigenous in origin remains to be determined.

Radiocarbon dating determined on two shells from different boreholes at the Terra Nova site, but both within unit 2 at 11 and 14 m subbottom, show significantly different ages (i.e. 8,890 and 29,350 ybp). The dates should be treated with caution as the younger shell may be cavings, falling form the top of the hole and similarly, the older shell could be reworked.

Physical property data has yet to be fully analyzed, but preliminary results from the cone penetrometer suggest that there is a strong correlation between the lithology and the cone test data, especially from the pore pressure response. Preliminary results for 88-400-06 are presented in Figure 4. The cone penetrometer results can be calibrated against grain size analysis from intervals where samples have been taken. The cone data can then be used to extrapolate the lithostratigraphy to fill gaps between sample intervals. The pore pressure response has the potential resolution of 5

mm. A positive pore pressure response correlates with silty clays, a hydrostatic response is correlatable to well sorted sands, which in this case are generally the fine sand beds, and a negative pore pressure response correlates with sands with a high silt content. In the case of our data the negative response correlates with the medium and coarse sand intervals which tend to be moderately to poorly sorted. This pore pressure response shows the complex interbedded nature of the lithostratigraphy, better than borehole sediment sampling.

Appendix "A"
Lithologic Descriptions
and
Graphic Columns

88400-01
Summary of Core Descriptions

0 - .42 **VERY FINE SAND** (5Y 4/3, olive) abundant shell fragments, scattered pebbles; .2 -.3 m was void, no recovery; shelly bed at .42 m

1 - 1.14	**COARSE SAND** (5Y 7/2, light grey) shell hash, pebbly between 1 and 1.08 m.
1.14 - 1.21	**PEBBLE CONGLOMERATE** (5Y 7/2, light grey), abundant shells, pebbles > 1 cm.
2.0 - 2.44	**PEBBLE CONGLOMERATE** (5Y 7/2, light grey), abundant shells, pebbles > 1 cm., shells increase from 2.20 to 2.44 m.
4.0 - 4.16	**SAND, fine to medium** (5Y 5/0, grey), pebbles and shell fragments from 4.0 - 4.1 m.
5.0 - 5.3	**SAND, very fine with cobbles** (5Y 5/0, grey), shell fragments.
6.0 - 6.1	**SAND, medium to coarse** (5Y 5/0, grey), pebbles and shell hash.
6.1 - 6.2	**SAND TO CLAY WITH COBBLES**, very fine sand, (5Y 4/0, dark grey).
7.0 -7.27	**SAND**, fine to medium (5Y 5/0, grey), clay pockets, shell hash.
8.0 - 8.49	**SANDY CLAY** (5Y 5/0, grey), medium to coarse sand, shell fragments, sand and shell may be drill cuttings.
9.0 - 9.4	**PEBBLY SAND** (5Y 4/1, dark grey), abundant shell fragments, void at 9.1 to 9.2 m.
11.0 - 11.38	**SILTY CLAY** (5Y 3/1, very dark grey), scattered pebbles, very stiff, very fine sand from 11.36 to 11.38 m.
12.0 - 12.62	**CLAY** (5Y 3/1, very dark grey), 12 -12.07 drill cuttings, occasional silt laminae, black organic specs, fissile.
13.0 - 13.58	**SANDY SILT** (5Y 3/1, very dark grey), very fine sand, split surface showed clay laminae.
14.0 - 14.42	**SANDY SILT** (5Y 3/1, very dark grey), occasional very fine sand laminae, drill cuttings from 14 - 14.1.
14.42 -14.64	**SILTY CLAY** (5Y 3/1, very dark grey), scattered fine sand and sandy patches.
15.0 - 15.59	**SILTY CLAY WITH SAND** (5Y 3/1, very dark grey), grades from SILTY MUD at 15 m to MUDDY SAND at 15.37, very fine sand at 15.07 grades to fine to coarse sand at 15.59, drill cuttings from 15.0 to 15.07 m.

16.5 - 17.0	**MUDDY SAND** (5Y 3/1, very dark grey), very fine sand, drill cuttings from 16.5 to 16.53 m.
18.0 - 18.62	**SILT TO SILTY SAND** (5Y 3/1, very dark grey), silt with very fine sand grades to silty sand.
19.5 - 19.69	**MUDDY SAND** (5Y 3/1, very dark grey), very fine sand.
21.0 - 21.51	**SILT AND SAND**, very fine sand (5Y 3/1, very dark grey), sand laminae at 21.3, 21.4 and 21.48 m.
23.5 - 23.96	**SILTY CLAY** (5Y 3/1, very dark grey), scattered sand, black organic specs.
25.0 - 25.6	**SILT** (5Y 3/1, very dark grey), graded muddy silt to very fine sand at 25.6 m, organic specs.
26.5 - 27.17	**SILTY CLAY** (5Y 3/1, very dark grey), colour banding at 1 to 2 cm intervals, mica flakes and organic specs.
28.0 - 28.53	**SILT** (5Y 3/1, very dark grey), muddy silt grading to silty very fine sand at 28.53 m, mica flakes.
30.0 - 30.36	**SILT** (5Y 3/1, very dark grey), grades from silty clay at 30 m to sandy silt at 30.36 m.
30.36 - 30.54	**SAND, very fine** (5Y 3/1, very dark grey), loose.
33.0 - 33.25	**SILT** (5Y 3/1, very dark grey), with some very fine sand.
33.25 - 33.69	**SAND, very fine** (5Y 3/1, very dark grey), 2 to 4 cm beds.
36.0 - 36.53	**SAND, very fine** (5Y 3/1, very dark grey), silty sand at 36 m grading to sand with silt at 36.53 m.
39.0 - 39.63	**SAND, very fine** (5Y 3/1, very dark grey), bedded.
42.0 - 42.27	**SAND, very fine** (5Y 3/1, very dark grey).
45.0 - 45.60	**SAND, very fine** (5Y 3/2, dark olive grey), loose.
48.0 - 48.52	**SAND, very fine** (5Y 3/2, dark olive grey), some silt.
51.0 - 51.48	**SAND, very fine** (5Y 3/2, dark olive grey), some silt.
51.48	**END OF HOLE**

88400-02
Summary of Core Descriptions

0 - .44	**SAND, fine** (5Y 5/3, olive), with shell mash.
1.0 - 1.05	**CLAY** (2.5Y 4/0, dark grey), with coarse sand.
2.0 - 2.08	**CLAY** (2.5Y 4/0, dark grey), very stiff, with sand.
3.0 - 3.12	**SAND, fine to medium** (5Y 5/1, grey), abundant shells, forams.
5.7 - 5.92	**SAND, medium to coarse** (5Y 4/1, dark grey), abundant shell fragments, sorted.
7.0 - 7.23	**SAND, very fine to medium** (5Y 4/1, dark grey), very fine sand from 7.0 to 7.03 m and fine to medium sand from 7.03 to 7.23 m, shell fragments.
7.23 - 7.37	**SILT** (5Y 4/1, dark grey), very stiff with some very fine sand.
9.0 - 9.15	**SILTY CLAY** (5Y 3/1, very dark grey), with mica flakes and organic specs, very stiff.
10.0 - 10.14	**SILTY CLAY** (5Y 4/1, dark grey), with some broken shells, some drilling disturbance.
11.0 - 11.54	**SAND, fine to medium** (2.5Y 4/2, dark greyish brown), with shell fragments and coarse sand at 11.54 m.
12.0 - 12.2	**CLAY** (5Y 4/1, dark grey), very stiff.
13.0 -13.38	**CLAY** (5Y 4/1, dark grey), stiff.
14.0 - 14.18	**SANDY CLAY** (5Y 4/1, dark grey), stiff.
15.0 -15.05	**SANDY CLAY** (5Y 4/1, dark grey), stiff.
18.0 - 18.10	**SANDY CLAY** (5Y 4/1, dark grey), stiff.
21.0 - 21.23	**CLAY** (5Y 4/1, dark grey), very stiff.
24.0 - 24.23	**CLAY** (5Y 4/1, dark grey), very stiff.
27.0 - 27.17	**CLAY** (5Y 4/1, dark grey), very stiff.
30.0 - 30.22	**CLAY** (5Y 4/1, dark grey), very stiff.
30.22 - 30.42	**SILTY SAND** (5Y 4/1, dark grey).
30.42 - 30.52	**CLAY** (5Y 4/1, dark grey), stiff.

33.0 - 33.09	**CLAY** (5Y 4/1, dark grey), very stiff.
36.0 - 36.10	**CLAY** (5Y 4/1, dark grey), very stiff.
36.1 - 36.43	**SILTY SAND** (5Y 4/1, dark grey), very fine sand.
39.0 - 39.38	**CLAY** (5Y 4/1, dark grey), very stiff.
42.0 - 42.45	**CLAY** (5Y 4/1, dark grey), very stiff, some pockets of very fine sand.
45.0 - 45.12	**CLAY** (5Y 4/1, dark grey), firm.
48.0 - 48.42	**SILTY CLAY** (5Y 4/1, dark grey), some silt and sand from 48.22 to 48.42 m.
51.0 - 51.12	**CLAY** (5Y 4/1, dark grey).

88400-03
Summary of Core Description

Depth	Description
0.0-0.21	**SAND**, fine (5Y 5/2, olive grey), coarse sand, fine gravel, and shell fragments from .13 to .2; thin silt layer at the seabed/water interface.
0.21-0.25	**GRAVEL** (5Y 5/2, olive grey), with shell fragments; sharp upper contact at .21 m.
1.0 - 1.03	**SANDY SILT**, poorly sorted, shell fragments.
4.0 - 4.21	**CLAY** (5Y 3/1, very dark grey), abundant sand, small pebbles and shells.
5.0 - 5.2	**CLAY** (5Y 3/2, dark olive grey), with scattered sand and shell fragments, hard, 5.0 to 5.09 m drill cuttings.
6.0 - 6.45	**CLAY** (5Y 2.5/2, black), with gravel, sand and shell fragments, occasional large gravel, hard.
7.0 - 7.39	**CLAY** (5Y 3/2, dark olive grey) with scattered sand, increasing silt with depth, hard.
8.0 - 8.53	**CLAY** (5Y 3/2, dark olive grey) with small sand pockets, very stiff.
10.0 -10.66	**CLAY** (5Y 3/2, dark olive grey) with small sand pockets, very stiff.
11.0 - 11.39	**CLAY** (5Y 3/2, dark olive grey) with small sand pockets, and some pebbles, very stiff.
12.0 - 12.47	**CLAY** (5Y 4/1, dark grey) with small sand pockets, and some pebbles, very stiff.
13.0 - 13.34	**CLAY** (5Y 4/1, dark grey) with small sand pockets, and some pebbles, very stiff.
14.0 - 14.47	**CLAY** (5Y 4/1, dark grey) with small sand pockets, very stiff.
15.0 - 15.49	**CLAY** (5Y 4/1, dark grey) with small sand pockets, very stiff.
18.0 - 18.53	**CLAY** (5Y 4/1, dark grey), fine sand layers, very stiff.
21.0 - 21.2	**CLAY** (5Y 4/1, dark grey), stiff.
21.2 - 21.53	**SILTY SAND** (5Y 4/1, dark grey), very fine sand.
24.0 - 24.1	**CLAY** (5Y 4/1, dark grey), soft, possibly cuttings.
24.1 - 24.53	**SILTY SAND** (5Y 4/1, dark grey), fine to medium sand.

88400-04
Summary of Core Descriptions

Depth	Description
0.0 - 0.5	**SAND**, fine (5Y 5/3, olive), clean sand from 0 to 0.13 m, shell fragments from 0.13 to 0.5 m, several organic rich silt layers.
1.0 - 1.26	**SAND**, fine to medium (2.5Y 4/0, dark grey), abundant shell fragments, large pebbles from 1.17 to 1.26 m, clay ball at 1.24 to 1.26 m.
2.0 - 2.67	**CLAY**, (5Y 3/1, very dark grey), with silt and some scattered sand, stiff.
3.8 - 4.2	**SILTY CLAY**, (5Y 2.5/1, black), stiff, abundant shells at 3.8 to 3.82 m, one large decomposed shell at 3.95 m.
5.0 - 5.07	**SILTY CLAY**, (5Y 2.5/1, black) with scattered sand.
5.07 - 5.32	**SILT AND SAND**, very fine (5Y 3/1, very dark grey).
6.0 - 6.48	**SILT**, (5Y 3/1, very dark grey), with very fine sand at 6 m grading to clayey silt at 6.2 m with black silty patches.
7.0 - 7.36	**SAND**, very fine (5Y 3/1, very dark grey); grades from clayey silt and sand to very fine sand with silt from 7.0 m to 7.2 m.
8.0 - 8.3	**SAND**, very fine (5Y 3/1, very dark grey), with some silt, mica flakes, and sand bed at 8.27 m.
9.0 - 9.19	**SAND**, very fine **AND SILT** (5Y 3/1, very dark grey).
9.19 - 9.35	**SILT AND CLAY** (5Y 3/1, very dark grey) with very fine sand, sharp contact at 9.19 m.
10.0 - 10.46	**SILTY CLAY** (5Y 3/2, dark olive grey) with some sand, mica flakes.
11.0 - 11.53	**SILTY CLAY** (5Y 3/2, dark olive grey) with some very fine sand, thin very fine sand lamina at 11.09 m, more silt and sand near 11.5 m.
12.0 - 12.27	**SILTY CLAY** (5Y 3/2, dark olive grey) with very fine sand and mica flakes.
13.0 - 13.28	**SILTY CLAY** (5Y 3/1, very dark grey and 5Y 3/2, dark olive grey, marbled) with scattered sand.
14.0 - 14.48	**SILTY CLAY** (5Y 3/1, very dark grey) with fine sand and scattered coarse sand, and silt partings at 14.06, 14.13, and 14.27 m, and shell fragments at 14.08 and 14.13 m.
14.48 - 14.61	**SILTY CLAY** (5Y 3/1, very dark grey and 5Y 3/2, dark olive grey, marbled).
15.0 - 15.08	**SILTY CLAY** (5Y 3/1, very dark grey) with silt parting at 15.08 m.

15.08 - 15.16 **SILT AND CLAY** (5Y 3/1, very dark grey).

15.16 - 15.51 **SILT** (5Y 3/1, very dark grey) with very fine sand.

15.51 - 15.60 **SAND**, very fine (5Y 3/1, very dark grey) with some silt.

18.0 - 18.46 **SAND**, very fine (5Y 3/2, dark olive grey) with some silt, increasing fine sand from 18.2 to 18.46 m, small red (2.5YR 4/6) clay ball at 18.38 m.

21.0 - 21.22 **MUDDY SAND** (5Y 3/2, dark olive grey) with sand patches.

21.22 - 21.67 **SAND**, very fine (5Y 3/2, dark olive grey) with some silt and occasional coarse sand.

24.0 -24.30 **SAND**, fine (5Y 3/2, dark olive grey) with silt and silt parting at 24.12 m.

88400-05
Summary of Core Descriptions

Depth	Description
0.0 - 0.16	**SAND**, fine (5Y 5/2, olive grey) well sorted.
0.95 - 1.49	**CLAY** (5Y 5/1, grey) with shells.
1.92 - 2.56	**CLAY** (5Y 5/2, olive grey), stiff.
2.94 - 3.28	**CLAY** (5Y 5/2, olive grey), stiff.
4.16 - 4.33	**CLAY** (5Y 3/2, dark olive grey), very stiff.
4.33 - 4.51	**CLAY** (5Y 3/1, very dark grey), very stiff.
5.14 - 5.61	**CLAY** (5Y 3/1, very dark grey), very stiff to hard.
6.03 - 6.51	**CLAY** (5Y 3/1, very dark grey), very stiff, drill cuttings from 6.03 to 6.05 m.
8.0 - 8.41	**CLAY** (5Y 3/1, very dark grey), very stiff to hard.
9.96 - 10.41	**CLAY** (5Y 3/1, very dark grey), very stiff to hard.
11.92 - 12.33	**CLAY** (5Y 3/1, very dark grey), very stiff to hard.
13.87 - 14.05	**CLAY** (5Y 3/1, very dark grey), hard.
15.79 - 16.02	**CLAY** (5Y 3/1, very dark grey), stiff.

88400-06
Summary of Core Descriptions

Depth	Description
5.25-5.32	**SILTY CLAY with sand** and pebbles (5Y 3/1, very dark grey). Abundant mica flakes and some organic flecks. Possibly some subtle coarser laminae.
5.32-5.5	**SAND, fine** (5Y3/1, very dark grey). Slightly silty to silty sand. Abundant mica.
6.27-6.54	**SILTY CLAY** (5Y3/1, very dark grey). Minor sand, dark organic flecks, some mica.
7.31-7.77	**SILTY CLAY** (5Y3/1, very dark grey). Sandier towards the base, possibly in wispy laminae.
8.49-8.7	**SILTY CLAY with sand** (5Y 3/1, very dark grey). Abundant mica flakes and some black organic flecks. Some subtle coarser laminae. Sand occurs in patches and lenses.
8.7-8.85	**CLAY**, dark laminae
9.36-9.89	**SILTY CLAY with sand** (5Y 3/1, very dark grey). Black organic flecks throughout. Sand occurs in patches and lenses. Mud balls apparent. Slightly siltier towards the base.
10.67-10.75	**SILTY CLAY** (5Y 3/1, very dark grey). Black organic flecks throughout.
11.41-11.50	**FINE SAND with medium sand** (5Y 3/1, very dark grey). Burrow structures obvious.
11.5-12.09	**SILTY SANDY CLAY** (5Y 3/1, very dark grey). Sand in lenses, patches, and thin beds which apppear well sorted. Mottled appearance to core. White chalky particles that react with HCL at about 11.7 m. Mica flakes abundant.
12.44-12.6	**SILTY CLAY with sand** (5Y 3/1, very dark grey). Sand occurs in patches and lenses. Abundant mica flakes.
12.7-12.96	**SAND, fine** in a silty clay matrix (5Y 3/1, very dark grey). Structureless.
12.96-12.98	**SILTY CLAY** (5Y 3/1, very dark grey). Sharp contact at top.
13.52-12.84	**SILTY CLAY** (5Y 3/2, very dark grey). Black organic flecks and mica flakes abundant.
14.62-15.09	**SILTY CLAY** with sand in lenses and patches. Bioturbation traces.
15.65-16.01	**SILTY CLAY** (5Y4/1), with sand in lenses and patches and laminae of silt.
17.64-17.9	**SAND, fine to medium** (5Y3/2, Dark Olive Grey) with discontinuous mud lenses.
19.65-19.73	**SAND, fine to medium** (5Y3/2, Dark Olive Grey) with silt and rare discontinuous mud lenses.
21.47-21.62	**SAND, fine to medium** (5Y3/2, Dark Olive Grey), clean, well sorted. Worm tube.

23.5-23.8	**SAND, fine to medium** (5Y3/2, Dark Olive Grey), clean, well sorted. Dark organic patch.
25.47-25.64	**SAND, fine to medium** (5Y3/2, Dark Olive Grey). Scattered coarse granules and mica flakes.
27.24-27.6	**SAND, fine to coarse** (10YR4/2 Dark greyish brown to 5Y4/2 Olive grey). With pebbles, and muddy matrix. Clay balls between 27.46-27.5 m.
28.3-28.79	**SILTY CLAY, with sand and pebbles** (5Y3/2, Dark olive grey). sand occurs in lenses, patches and laminae, laminae especially towards base. Rare pebbles.
29.5-29	**SAND, fine to coarse** (5Y2.5/1). Scattered granules. Mottled appearance. Organic rich zones, siltier zones, and mud-rich zones.
31.17-31.5	**SAND, medium** (5Y3/1), poorly sorted, fine to coarse sand, slightly fining up.
33.15-33.5	**SAND, medium** (5Y3/2), poorly sorted, fine to medium sand, slightly grading down. Some silt and H_2S odour.
35.17-35.2	**SILTY CLAY** (7.5 YR2/10 Black). Organic clay
35.2-35.63	**SAND and CLAY** (7.5 YR3/0). Distorted clay in matrix of poorly sorted medium to coarse sand (5Y 3/2 dark olive grey). Coarser towards the bottom.
37.2-37.45	**SAND, medium to coarse** (5Y3/1 very dark olive grey). Subangular sand, coarse from 37.27-37.34 m.
40.25-40.51	**SAND, fine to medium**. Abundant organics. Clayball at 40.46 m
42.27-42.91	**SAND, fine** with silt (5Y3/1 to 5Y3/2). Massive.
44.3-44.91	**SILTY SAND, fine** (5Y3/2 dark olive grey). Scattered blebs of sandy clay.
46.34-46.87	**SAND,fine to coarse** with some silt (5Y3/1 very dark grey). Bioturbation trails and some laminations.
50.40-50.90	**CLAYEY SILT AND SILTY SAND** (5Y3/2 dark olive grey). Worm burrow and burrow infilling with fine sand = sand patches and lenses.
52.54-52.92	**SILTY SAND, fine** (5Y3/2 dark olive grey). Inclusions of silty clay, obvious burrow structures, and burrow infilling.
54.5-55.0	**SILTY SAND, fine** (5Y3/2 dark olive grey). Scattered inclusions of silty clay, and burrow infilling.
56.5-56.6	**SAND, fine** (5Y3/1 very dark grey). Massive, hard.
56.6-57.0	**SAND, fine,** (5Y3/2 dark olive grey). Silty with silty clay inclusions and mottles. Mottles are 5Y4/2.
58.52-58.9	**SILTY SAND, fine to medium** (5Y3/2 dark olive grey). Poorly sorted with silty clay inclusions and mottles.

60.51-60.76	**SAND, fine to coarse** (5Y3/2 dark olive grey) with silt. Poorly sorted with silty clay inclusions and mottles.
61.47-61.81	**SAND, fine to coarse** (2.5Y3/0 very dark grey). Poorly sorted, silty, massive. Pebble.
62.38-62.7	**SAND, fine to coarse** (2.5Y3/0 very dark grey). Poorly sorted, silty, massive, mottled appearance.
63.35-63.49	**SAND, fine to medium** (5Y3/1) with sandy silt inclusions or mottles (5Y5/1).
63.49-63.51	**SAND, medium to coarse**
63.51-63.62	**SILTY SAND**, fine to coarse sand, poorly sorted.
64.31-64.61	**SILTY SAND, fine to coarse** (5Y3/2 dark olive grey). Poorly sorted, massive and mottled. Better sorted toward base.
65.21-65.49	**SAND, fine to medium** (5Y3/2 dark olive grey). Generally massive.
66.15-66.33	**SAND, medium** (5Y3/2 dark olive grey). Vaguely stratified with bands of sandy clayey silt.
67.12-67.47	**SAND, fine to coarse** (5Y3/2 dark olive grey to 5Y4/1 dark grey). Zone of hard silty fine sand at 67.37 m. Contains granules and pebbles of well rounded, smooth quartz.
68.05-68.34	**SAND, fine to medium** (5Y4/1 dark grey). Colour banding with 2.5Y3/0 towards base.
69.01-69.40	**SAND, fine to coarse** (5Y3/2 dark olive grey). Scattered granules throughout. Burrow structure (in situ living chamber) above 69.1 m).
69.87-70.1	**SAND, fine to medium** (5Y4/1 dark grey). Massive. 4 cm Pebble at 69.96 m.
70.1-70.2	**SAND, fine** with silt (5Y3/1) and sandy silt clay bands (5Y4/1).
71.02-71.23	**SAND, fine** (5Y3/1) with distorted clay layers (5Y4/1). Vertical burrow structures.
74.13-74.38	**SAND, fine** (5Y2.5/1) Massive with distorted clay bands (mottles) (5Y4/1).
77.17-77.24	**SILTY CLAY** (5Y4/1) Massive with sharp contact below.
77.24-77.57	**SAND, fine** (5Y3/1). Moderately well sorted, scattered mica, numerous clay mottles.
80.25-80.3	**SILTY CLAY** (5Y4/1). Distorted clay layer, sharp lower contact.
80.3-80.52	**SAND, fine** (5Y3/1). Faint laminations, patches and lenses of clayey sand.
83.35-83.86	**SILTY CLAY** (5Y4/1 dark grey). Hard and massive with flecs of black organic material.
86.37-87.03	**SILTY CLAY** (2.5Y4/0 black to 5Y3/1 very dark grey to 10YR5/1 light grey). Colour changes suggest vague laminae and mottling.

Cruise 88400
Sediment Subsample Summary

PH - photograph
PM - paleomagnetics
VE - velocity measurement
FS - foram subsample
CL - classification sample
BD - bulk density
WC - water content
XR - x-ray subsample
CON-consolidation sample
SV-shear vane
TV-torvane
FA-fabric
GS- grain size
PA-palynolgy subsample

Borehole 88400-01

Sample No.	Depth Interval (metres)	Subsamples
1	0-0.42	PH
2	1.01-1.22	PH
3	2.04-2.48	PH
5	3.84-4.0	PH
6	4.81-5.16	PH
7	5.79-5.99	PH
8	7-7.27	PH,PM,VE
9	8-8.49	PH,VE,BD
10	8.94-9.34	PH,CL
11	11.13-11.49	PH,FS,CL
12	12.12-12.84	PH,PM,FS,CL
13	13.12-13.7	PH,FS,CL,PM
14	14.11-14.75	PH,BD,VE,FS,CL
15	15.1-15.69	XR,VE,PM,BD,FS,CL,PH
16	16.59-17.09	BD,VE,PM,XR,FS,CL,PH
17	18.09-18.71	FS,PH,BD,VE,PM,CL,XR
18	19.58-19.77	PH
19	21.05-21.56	PH,BD,VE,PM,FS,CL,XR
20	23.54-24.0	PH,BD,VE,FS,CL,XR,PM
21	25.02-25.62	PH,PM,CL,XR,FS
22	26.51-27.18	PH,VE,PM,BD,FS,CL,XR
23	28.01-28.54	PH,XR,XR,FS,BD,VE,CL
24	30-30.55	PH,BD,VE,PM,FS,XR,CL
25	32.99-33.68	PH,CL,PM,FS,BD,VE,XR
26	35.98-36.51	PH,BD,PM,CL,XR,VE
27	38.98-39.61	PH,PM,CL,FS,BD,XR,VE
28	41.99-42.26	PH
29	45.02-45.62	PH,XR,CL,PM,VE,BD,FS
30	48.03-48.55	PH,VE,BD,FS,PM,CL,XR
31	51.04-51.52	PH,FS,PM,VE,BD,CL

Borehole 88400-02

Sample No.	Depth Interval (metres)	Subsamples
1	0-.44	PH
2	1.01-1.06	PH
3	2.03-2.11	PH
4	3.09-3.21	PH
5	6.11-6.33	PH
6	7.4-7.77	PH
7	8.35-8.5	PH
8	9.30-9.45	PH,FS,CL
9	10.29-10.43	PH,FS
10	11.21-11.75	PH,FS,CL
11	12.21-12.41	PH,FS
12	13.21-13.59	PH,BD,FS
13	14.22-14.4	PH,FS
14	15.23-15.28	PH
15	18.32-18.42	PH
16	21.34-21.57	PH,FS
17	24.35-24.58	PH
18	27.34-27.49	PH
19	30.29-30.81	PH,BD,VE,PM,FS,CL
20	33.15-33.24	PH
21	36.11-36.54	PH,BD,VE,FS,PM,CL,wood
22	39.05-39.43	PH,BD,VE,FS,PM,CL
23	42.03-42.48	PH,VE,BD,FS,CL
24	44.97-45.09	PH,FS,PM,VE,BD,CL
25	47.95-48.37	PH,FS
26	50.94-51.06	PH

Borehole 88400-03

Sample No.	Depth Interval (metres)	Subsamples
1	0-.25	PH
2	0.94-0.97	
3	3.79-4.0	PH,FS
4	4.77-4.97	PH,FS
5	5.75-6.2	PH,BD,VE,PM,FS,CL
6	6.74-7.13	PH,BD,VE,FS,PM,CL,XR
7	7.72-8.34	PH,BD,VE,PM,FS,CL
8	8.72-9.02	PH,FS,VE,CL,PM,BD,XR
9	9.73-10.12	PH,FS,BD,VE,PM,CL,XR
10	10.77-11.16	PH,FS,PM,VE,BD,CL
11	11.8-12.24	PH,VE,PM,FS,BD,CL,XR
12	12.85-12.19	PH,FS

13	13.92-14.39	PH,VE,PM,BD,CL
14	14.93-15.42	PH,FS,VE,PM,BD,CL
15	17.94-18.47	PH,BD,VE,PM,FS,CL,XR
16	20.92-21.45	PH,FS
17	23.89-24.43	PH,FS

Borehole 88400-04

Sample No.	Depth Interval (metres)	Subsamples
1	0-.5	PH,FS
2	1.02-1.28	PH,FS
3	2.07-2.74	PH,FS,VE,BD,PM,CL
4	3.94-4.34	PH,PM,BD,FS,XR
5	5.16-5.48	PH,FS
6	6.19-6.77	PH,PM,FS,BD,VE,CL,XR
7	7.23-7.59	PH,CL,BD,PM,FS,XR
8	8.27-8.58	PH,CL,FS,BD
9	9.28-9.63	PH,PM,CL,FS,BD,XR
10	10.3-10.76	PH,CL,BD,VE,FS,XR
11	11.33-11.86	PH,CL,XR,PM,VE,BD
12	12.35-12.62	PH,FS,BD,VE,PM
13	13.37-13.66	PH,XR
14	14.42-15.02	PH,VE,XR,PM,FS,BD,CL
15	15.44-16.04	PH,FS,VE,BD,PM,XR,CL
16	18.46-18.92	PH,XR
17	21.48-22.13	PH,FS,XR,BD,PM,CL,VE
18	24.51-24.81	PH,CL,PM

Borehole 88400-05

Sample No.	Depth Interval (metres)	Subsamples
1	0-.16	PH
2	0.95-1.49	PH,FS
3	1.92-2.56	PH,BD,FS,PA
4	2.94-3.28	PH,BD,FS,PA
5	4.16-4.51	PH
6	5.14-5.61	PH,BD,VE,FS,PA
7	6.03-6.51	PH,XR,BD,VE,PM,FS
8	8-8.41	PH,VE,BD,PA
9	9.96-10.41	PH,BD,VE,FS,PA
10	11.92-12.33	PH
11	13.87-14.05	PH,BD,VE
12	15.79-16.02	PH

Borehole 88400-06

Sample No.	Depth Interval (metres)	Subsamples
1	0-.57	PH
2	0.9-1.21	PH
3	1.87-2.22	PH
4	4.17-4.64	PH,FS
5	5.25-5.5	Split WC, PH,VE, PM, FS,BD, CON, GS
6	6.27-6.55	Split WC, PH,VE, FS,BD, CON, GS, SV, FA
7	7.31-7.76	Split WC, PH,VE, FS,BD, CON, GS, SV, FA, PM, PA
8	8.34-8.85	Split WC, PH,VE, FS,BD, CON, GS, TV, FA, PM, PA
9	9.36-9.89	Split WC, PH,VE, FS,BD, CON, GS, SV, FA, PM, PA
10	10.39-10.75	Split WC, PH, GS,FS, BD, SV
11	11.41-12.07	Split WC, PH, GS,FS, VE, PM, CON
12	12.44-13.09	Split WC, PH, GS, FS, PA, BD, TV, VE, PM, CON
13	13.48-13.85	Split WC, PH, GS, FS, PA, BD, SV, VE, PM, FA, CON
14	14.49-15.17	Split WC, PH, GS, FS, BD, SV, CON, FA, PM
15	15.5-16.02	Split WC, PH, GS, FS, PA, BD, SV, CON, FA, VE, PM
16	17.5-17.9	Split WC, PH, GS, FS, PA, BD, PM
17	19.43-19.71	Split WC, PH, GS, FS, PA, BD, PM
18	21.4-21.61	Split WC, PH, GS, FS, BD, PM
19	23.35-23.8	Split WC, PH, GS, FS, BD, PM
20	25.31-25.66	Split WC, PH, GS, FS, BD, PM
21	27.24-27.61	Split WC, PH, GS, FS, BD, PM
22	28.21-28.79	Split WC, PH, GS, FS, PA, BD, SV, VE, PM, CON
23	29.19-29.6	Split WC, PH, GS, FS, PA, BD, PM
24	31.17-31.5	Split WC, PH, GS, FS, BD, PM
25	33.13-33.57	Split WC, PH, GS, FS, VD, PM
26	35.11-35.66	Split WC, PH, GS, FS, BD, VE, PM
27	37.09-37.34	Split WC, PH, GS, FS, BD, PM
28	40.2-40.45	Split WC, PH, GS, FS, BD, PM
29	42.26-42.73	Split WC, PH, GS, FS, BD, PM
30	44.3-44.97	Split WC, PH, GS, FS, BD, PM
31	46.34-46.85	Split WC, PH, GS, FS, BD, PM
32	48.36-49.04	Split WC, PH, GS, FS, BD, PM
33	50.4-51.08	Split WC, PH, GS, FS, BD, CON, FA, VE, PM
34	52.47-52.95	Split WC, PH, GS, FS, BD, PM
35	54.48-55.08	Split WC, PH, GS, FS, BD, PM

36	56.49-57.0	Split WC, PH, GS, FS, BD, PM
37	58.49-58.87	Split WC, PH, GS, FS, BD, PM
38	60.48-60.8	Split WC, PH, GS, FS, BD, PM
39	61.46-61.79	Split WC, PH, GS, FS, BD, PM
40	62.38-62.71	Split WC, PH, GS, FS, BD, PM
41	63.32-63.62	Split WC, PH, GS, FS, BD, PM
42	64.27-64.58	Split WC, PH, GS, FS, BD, PM
43	65.2-65.48	Split WC, PH, GS, FS, BD, PM
44	66.13-66.33	Split WC, PH, GS, FS, BD, PM
45	67.1-67.46	Split WC, PH, GS, FS, BD, PM
46	68.05-68.31	Split WC, PH, GS, FS, BD, PM
47	69.01-69.44	Split WC, PH, GS, FS, BD, PM
48	69.87-70.27	Split WC, PH, GS, FS, BD, PM
49	70.92-71.24	Split WC, PH, GS, FS, BD, PM
50	74.12-74.38	Split WC, PH, GS, FS, BD, PM
51	77.17-77.59	Split WC, PH, GS, FS, BD, PM
52	80.25-80.52	Split WC, PH, GS, FS, BD, PM
53	83.3-83.86	Split WC, PH, GS, FS, BD, TV, SV, CON, FA, VE, PM
54	86.37-87.03	Split WC, PH, GS, FS, BD, SV, TV, CON, FA, VE, PM

Borehole 88400-07

Sample No.	Depth Interval (metres)	Subsamples
1	3.41-4.02	Split WC, PH, GS, FS
2	4.35-4.56	Split WC, PH, GS, FS
3	5.33-5.88	Split WC, PH, GS, FS
4	6.3-6.58	Split WC, PH, GS, FS
5	7.29-7.69	Split WC, PH, GS, FS
6	8.24-8.89	Split WC, PH, GS, FS
7	9.22-9.66	Split WC, PH, GS, FS
8	10.21-10.89	Split WC, PH, GS, FS
9	11.17-11.79	Split WC, PH, GS, FS
10	12.15-12.83	Split WC, PH, GS, FS
11	13.13-13.64	Split WC, PH, GS, FS
12	14.12-14.81	Split WC, PH, GS, FS
13	15.11-15.79	Split WC, PH, GS, FS

Borehole 88400-08

Sample No.	Depth Interval (metres)	Subsamples
1	2.08-2.21	Split WC, PH, GS, FS

Borehole 88401 G1

Depth (m)	Description
00.00-00.03	**Sand**, med., 5Y6/2 light olive grey, well rounded, sea urchins and sand dollars.
01.00-01.05	**Sand**, med. to cse., 5Y5/2 olive grey, abundant shells.
01.50-01.70	**Sand**, med. to cse., 5Y5/2 olive grey, graded: gravel at base, increasing shell fragments towards base, pebbles up to 1 cm.
02.00-02.19	**Sand**, med. to cse., cse towards base, 5Y5/2 olive grey, maximum size of pebbles 2.5 cm, increasing shell fragments towards base.
03.00-03.10	**Sand**, fine, 2.5Y5/0 grey to 5Y4/1 dark grey, some silt and minor shell fragments, calcareous.
05.00-05.07	**Sand**, med, 5Y4/1 dark grey, some silt, 1 pebble, stiff, minor shell fragments, slightly calcareous.
06.00-06.20	**Silty sand with clay**, fine sand, 5Y3/1 very dark grey, very stiff.
07.00-	Cuttings
07.50-07.82	**Sand and clay**, very fine sand, 5Y4/1 dark grey, laminated, sand partings 1 cm apart, very stiff.
08.00-08.20	**Sandy clay**, very fine sand, 5Y3/1 very dark grey, very stiff.
10.00-10.20	**Pebbly silt, clay and very fine sand**, 5Y3/1 very dark grey, very poorly sorted, abundant shells in crude beds. diamicton
10.20-10.60	Cuttings
10.60-10.77	**Pebbly silt, clay and very fine sand**, 5Y3/1 very dark grey, very poorly sorted, abundant shells in crude beds. diamicton.
11.00-11.50	**Clay**, 5Y3/1 very dark grey, minor silt, pebbles and shells. Pebbles and shells occur scattered and in crude layers. Cobble (mudstone) at base of sample (10 cm). Sample highly disturbed due to extruder.
12.00-12.15	**Sand**, fine, 2.5Y4/2 dark greyish brown, some silt. Sand stained - iron oxide, organics apparent on split face give mottled appearance.
12.15-12.40	**Sand with silt**, 2.5Y3/2 very dark greyish brown, some clay, inversely graded.
13.00-13.84	**Sand with silt**, fine sand, 5Y3/1 very dark grey, minor clay, occasional organic mottle.
15.00-15.54	**Sand with silt**, fine sand, cobble 15.00-15.10 cm. Cobble (mudstone) surrounded by clayey matrix.
16.00-16.08	**Clayey sand**, 5Y3/2 dark olive grey, soft, gravel, shell fragments, some organics, colour mottle.

= wash???

16.08-16.47 **Sand with silt**, apparently massive.

17.00-17.12 **Sand**, fine to med., 5Y3/2 dark olive grey, poorly sorted, abundant organics on split face.

17.12-17.37 **Sand**, fine with silt and some med. sand, iron oxide staining of sand. 17.25-17.26 bed of fine pebble and coarse sand. Below 17.30 no med. sand = better sorted.

17.37-17.61 **Silt**, with very fine sand, 5Y3/2 dark olive grey.

17.61-17.84 Preserved in Shelby tube.

18.00-18.46 **Sand**, fine with some silt, 5Y3/2 dark olive grey.

18.46-18.92 **Sand**, fine to med., and silt, 5Y3/2 dark olive grey, coarser sand in patches and silt in patches giving a mottled bioturbated appearance.

19.00-19.05 **Silty sand**, 5Y3/2 dark olive grey, some clay laminae and clasts.

19.05-19.28 **Sand**, fine to med., some cse., 5Y3/2 dark olive grey, sharp irregular contact at base.

19.28-19.33 **Sandy clay**, fine to med. sand, 5Y3/2 dark olive grey, faint structures = pillar structures or sand dykes.

19.33-19.54 **Sand and silt**, fine to med. sand, 5Y3/2 dark olive grey, clay nodules. Med. to cse sand from 19.50-19.54 m.

19.54-19.64 **Sand and silt**, fine to med. sand, buff colour, sharp dipping contact at top, dipping (15°) fine laminae structures.

21.00-21.08 **Sand silt and clay**, pebbles, shell fragments and cobble; possible wash.

21.08-21.30 **Sand, silt and clay**, 5Y3/1 very dark grey, graded: sand in silt and clay matrix at top to fine to med. sand with some cse. sand at base (21.20-21.30 m).

22.00-22.86 **Sand**, fine to med., 5Y3/2 dark olive grey, with minor silt, (to 22.12 m); fine to med. sand with cse.sand from 22.12 to 22.86 m), 1 cm pebble at 22.24m, Clay patch at 22.72-22.74 m.

23.00-23.32 **Sand**, med. to cse., 5Y3/2 dark olive grey, massive, poorly sorted sand.

24.00-24.10 **Sand**, med., 5Y3/2 dark olive grey, clay patch at 24.05 m. Sharp lower contact.

24.10-24.45 **Sand**, fine to med., 5Y3/2 dark olive grey, with clay matrix. Shells and pebble layer at 24.43 to 24.45 m.

27.00-27.27 **Sand**, med. to cse., 5Y3/2 dark olive grey, with occasional shell fragment.

28.00-28.38 **Sand**, med. to cse., 5Y3/2 dark olive grey, massive.

29.00-29.38 **Sand**, med. to cse., 5Y3/2 dark olive grey, massive.

32.00-32.40 **Sand**, med., 5Y3/2 dark olive grey, massive.

32.40-32.60 **Gravel**, fine to med., clay with small gravel layer at top (32.40-32.41 m); well rounded, well washed pebbles with abundant shells, and clay nodule.

33.00-33.33 **Sand**, med. to cse., 5Y3/2 dark olive grey, massive, trace gravel.

35.00-35.24 **Sand**, med., 5Y3/2 dark olive grey, 35.10-35.15 m laminated fine sand to silt that is iron stained.

37.00-37.11 **Sand**, med., 2.5Y3/2 very dark greyish brown (stain), laminated, laminae in very fine sand from 37.09 to 37.11 m (2.5Y5/6 light olive brown).

37.11-37.27 **Sand**, med., 2.5Y3/2 very dark greyish brown, apparently massive.

38.00-38.28 **Sand**, med., 5Y3/2 dark olive grey, massive.

41.00-41.51 **Sand**, med., 5Y3/2 dark olive grey, massive, some organics, slight colour changes. Sand with pebbles at top 6 cm (possible wash?), small plant stem or root found in this interval.

42.00-42.56 **Sand**, fine to med., 5Y3/2 dark olive grey, trace organics.

45.00-45.87 **Sand**, fine grading down section to very fine with silt, 5Y2.5/1 black, apparently structureless.

46.00-46.56 **Sand**, very fine with some silt, 5Y2.5/1 black, some organics.

Borehole 88401 G1A

Depth (m)	Description
48.00-48.64	**Silty clay**, 5Y2.5/1 black and 5Y3/2 dark olive grey, marbled appearance, darker marbles due to organics.
49.00-49.89	**Silty clay** grading to **sandy silt**, then, **very fine sand and silt**, 5Y3/2 dark olive grey and 5Y2.5/1 black, marbled appearance, massive.
52.00-52.60	**Silty sand**, very fine, 5Y3/2 dark olive grey and 5Y2.5/1 black marbled appearance due to organics -though amount of organics decreasing, trace small clay mottle.
53.00-53.89	**Silty sand with clay**, 5Y3/1 very dark grey, clay occurring in abundant mottles, rare sorted sand patches.
56.00-56.17	**Sand**, med., some silt and fine sand down core, slightly clayey at top, clay bed at 56.02 m, 5Y3/1 very dark grey.
57.00-57.30	**Sand**, med. to cse., some fine pebbles, 5Y3/2 very dark olive grey, apparently massive.
59.00-59.11	**Sand**, med. to cse., some fine pebbles, 5Y3/2 very dark olive grey, apparently massive.

59.11-59.41 Cuttings, some med. to cse. olive grey sand.

61.00-61.20 **Sand**, med. to cse., minor fine, 5Y3/2 dark olive grey, massive, one shell fragment at 61.05 m.

64.00-64.25 **Sand**, fine to med., minor silt, mottled appearance between 64.04 and 64.11.

65.00-65.10 **Sand**, fine to med., minor silt, organic specks. 65.10-65.45 is cuttings ?.

66.00-66.18 **Sand**, fine, 5Y3/2 dark olive grey, 66.00-66.08 m a large cobble of sandstone with an apparently weathered surface??

69.00-69.50 **Silty very fine sand** at top grading to **sandy silt with clay** at base, 5Y3/2 dark olive grey, split sample shows bedding.

70.00-70.40 **Silty sand**, very fine sand, clay marbled throughout (obvious on split sample), 5Y3/2 dark olive grey, 70.38-70.40 m distinct sand bed.

70.40-70.73 **Sand**, fine 5Y2.5/1 black, possibly laminated, high organic content (abundant black traces), strong H_2S odour.

72.00-72.07 **Cobbles**, sandstone fragments.

73.00-73.18 **Silt**, highly organic, soft, with shell fragments and scattered pebble, 5Y3/2 dark olive grey.

76.00-76.42 **Silt**, high organic content, abundant shell fragments (Wash??), 5Y3/2 dark olive grey, strong H_2S odour. Abundant pebbles at top, decreasing downcore to occasional, some very fine sand.

77.00-77.39 Pebbles and shell hash (Wash?) from 77.00-77.26 m, organic **Silt**, soft and structureless from 77.26 to 77.39 m.

80.00-80.80 **Silty sand**, very fine sand, 5Y3/2 dark olive grey, small clay mottles, H_2S odour.

81.00-81.48 **Sand**, very fine, 5Y3/2 dark olive grey, soft, abundant small clay mottles, strong H_2S odour.

84.00-84.80 **Silty clay**, 5Y3/1 very dark grey, less silt towards base, silt and very fine sand occurring in patches, black organic marbling at top, strong H_2S odour.

85.00-85.90 **Clay**, 5Y3/2 dark olive grey, colour marbling, darker organics form pillar structures, strong H_2S odour.

88.00-88.94 **Clay**, 5Y3/2 dark olive grey, colour marbling, H_2S odour.

89.00-89.90 **Clay**, with minor silt, 5Y3/2 dark olive grey, colour marbling, H_2S odour.

92.00-92.80 **Clay**, with minor silt, 5Y3/2 dark olive grey, colour marbling, amount of organics (black) appears to be decreasing, H_2S odour.

93.00-93.87 **Clay** 93.00-93.08 m, grading to **silt and clay**, from 93.08-93.40 m, grading to **very fine sand with silt**, 5Y2.5/1 black, possibly bedded, parallel fabric obvious on fresh fracture surface,

H_2S odour apparent.

96.00-96.82 **Sand and clay**, fine sand, 5Y2.5/1 black, very stiff, apparently massive, H_2S odour.

97.00-97.92 **Sand and clay**, fine sand, 5Y2.5/1 black, mottled appearance when split, strong H_2S odour.

100.-100.71 **Sand and clay**, fine sand, increasing sand down core, 5Y2.5/1 black, split surface appears mottled with sandy patches in clay.

101.-101.89 **Sand with clay**, grading to **sand and clay**, colour mottling, clay mottles, 5Y2.5/1 black, H_2S odour.

104.-104.89 **Sand and clay**, colour mottling, clay mottles, 5Y2.5/1 black, H_2S odour.

105.-105.71 **Clay**, 5Y4/1 dark grey, very stiff to hard, near vertical sand dykes throughout, sand bed between 105.17-105.23 m.

109.-109.90 **Silt and sand** with minor clay, 5Y2.5/1 black, clay laminae apparent on split surface, H_2S odour.

113.-113.12 **Silt and sand** with some clay, 5Y2.5/1 black.

113.12-113.60 **Clay** with silt and fine sand, 5Y3/1 very dark grey, clay blocks, bioturbation trails = sandy traces, from 113.22-113.60 m.

113.60-113.84 **Sand and silt**, minor clay, fine sand, 5Y2.5/1 black.

114-114.85 **Silt with clay**, abundant organics, 5Y2.5/1 black, highly disturbed sample from 114.0-114.65 m.

118-118.85 **Silt with clay**, 2.5Y2/0 black, silt and clay bed between 118.10 and 118.25 m, pyrite worm burrows between 118.10 and 118.25 m. Gradational change in colour to 5Y3/1 very dark grey at about 118.55 m.

Borehole 88401 G2

Depth (m)	Description
00.00-00.10	**Sand** and fine to med gravel, shell fragments
02.00-02.32	**Sand**, fine to medium, 10YR4/2 greyish brown, small shell fragments.

Borehole 88401 G2A

Depth (m)	Description
10.00-10.02	**Clay**, 5Y3/1 very dark grey, with fine sand, very stiff.
10.05-10.52	**Clayey sand**, 5Y3/1, very dark grey, med. to cse sand, with small angular rock fragments.
14.00-14.14	**Sand**, med. to cse., 5Y3/1 very dark grey, fine gravel, abundant shell fragments.
18.00-18.10	**Sand**, fine-med. 5Y3/1 very dark grey, few shell fragments, rare small pebbles.
22.00-22.06	**Sand**, med. to cse., iron staining, small shell fragments.
22.06-22.25	**Sand and Gravel**, cse. sand to fine gavel, heavily reworked shell fragments.
26.00-26.37	**Sand**, fine to med., 5Y4/1 olive grey, less med sand towards base, mafic grains of sand about 5%.
30.00-30.20	**Sand**, fine to med., 5Y4/1 olive grey, trace gravel and shell fragments, gravel clasts 4 cm and 1.5 cm large (possibly cavings).
34.00-34.13	**Sand**, cse. to med., 5Y4/1 olive grey, with small gravel, shell fragments.
34.13-34.25	**Sand**, fine t med., 5Y4/1 olive grey.
40.00-40.30	**Sand**, fine, 5Y4/1 olive grey, with med. sand, mafic grains about 5%
44.00-44.94	**Sand,** very fine, 5Y2.5/2 black (very dark olive grey in appearance), minor silt increasing in content down core.
48.00-48.96	**Clay**, 5Y2.5/2 black, minor silt.

Borehole 88401 G3

Depth (m)	Description
05.-5.35	**Silty clay**, 5Y3/1 very dark grey, minor fine to med. sand, abundant shell fragments.
05.50-6.03	**Clay and silt**, 5Y3/1 very dark grey, with some very fine sand, increasing silt down core, very stiff.

Borehole 88401 G4

Depth (m)	Description
03.00-	No sample recovered, traces of fine sand and shell fragments in split spoon tray.
07.00-07.10	**Cobbles** (cobble layer - have drilled through but not sampled in previous holes). Basalt and granite.

07.10-07.15 **Sand**, fine to cse., 5Y4/1 dark grey, with small gravel and shell fragments.

08.00-08.30 **Sand**, fine to med., 5Y4/1 dark grey, well sorted, abundant shell fragments, mafic grains, trace gravel and larger shell fragments at base.

Borehole 88401 G5

Depth (m)	Description
00.00-00.14	**Sand**, fine to med. to coarse down core (graded), 5Y4/1 dark grey, shell fragments and granules from 10-14 cm.

Borehole 88401 G6

Depth (m)	Description
03.00-03.47	**Sand**, med. to cse., to fine gravel = graded, abundant shell fragments, probably all wash.
07.00-07.10	**Cobble** fragments, banded gneiss.
08.00-08.10	**Cobble** fragments, meta-sandstone or possible olivine basalt, and biotite gneiss.

Borehole 88401 G7

Depth (m)	Description
03.00-03.12	**Sand**, fine, 5Y4/1 dark grey, rare gravel, numerous shell fragments.
07.00-07.20	**Sand**, fine to medium, 5Y4/1 dark grey, small shell fragments.
11.00-11.46	**Clay**, with medium to coarse sand, shell fragments, 5Y3/1 very dark grey, 11.04-11.08 cm fractured rock.
15.00-15.16	**Silt with clay**, medium to coarse angular sand, shell fragments, with coarse sand to fine gravel, 5Y3/2 dark olive grey, shell fragments.
19.00-19.15	**Sand with silt**, fine grained, 5Y3/1 very dark grey.
19.15-19.36	**Sand**, medium to coarse, with silt, 5Y3/2 dark olive grey, abundant clay balls, 5Y4/1 dark grey.
19.36-19.57	**Sand**, medium to coarse with silt, coarsening down core, 5Y3/2 dark olive grey.
24.00-24.07	**Sand**, fine to medium with clay, 5Y3/1 very dark grey.
24.07-24.35	**Sand**, medium to coarse, coarsening downcore, 5Y3/2 dark olive grey, 24.07-24.20 cm patches of fine sand in clay.

24.35-24.40	**Sand**, fine to medium with clay, 5Y3/1 very dark grey.
28.00-28.40	**Sand**, medium to coarse, minor silt, 5Y3/2 dark olive grey.
32.00-32.40	**Sand**, medium to coarse, minor silt, 5Y3/2 dark olive grey, abundant 1-2 cm clay balls, 32.27-32.34 cm clay-silt pocket.
36.00-36.24	**Sand**, medium to coarse grading to fine to medium, trace of coarse sand, 5Y3/1 very dark grey.

Borehole 88401 G8

Depth (m)	Description
02.00-02.07	**Sand**, fine, shell fragments, light grey, disturbed.
06.00-06.20	**Silt**, clayey with fine sand and cobbles, hard, 5Y3/1 very dark grey, fragmented rocks, disturbed sample.
11.00-11.43	**Clay**, clay with fine to medium grained gravel, 5Y3/1 very dark grey, shell fragments.
16.50-16.52	**Silt**, silt with fine gravel, 5Y3/1 very dark grey.
20.00-20.33	**Silt**, with fine to medium gravel, 5Y3/2 dark olive grey, abundant shell fragments, = cuttings.
20.33-20.95	**Sand**, medium grained with silt grading to fine to medium grained with silt, 5Y3/2 dark olive grey, 20.53-20.67 cm medium to coarse sand patches.
25.00-25.13	**Sand**, coarse sand and fine gravel, 5Y3/2 dark olive grey, abundant shell fragments, cuttings.
29.00-29.22	**Sand**, medium to coarse, 5Y3/2 dark olive grey, few shell fragments, 29.18-29.22 cm rock.
33.00-33.40	**Sand**, medium to coarse grained with silt, 5Y3/2 dark olive grey.
37.00-37.15	**Sand**, medium grained, trace silt, apparently massive.
42.00-42.42	**Sand**, medium grained with increasing silt content downcore, 5Y3/2 dark olive grey, apparently massive.
46.00-46.09	**Silt**, silt and fine gravel, 5Y3/1 very dark grey, abundant shell fragments, = cuttings.
46.09-46.81	**Silt**, silt with fine sand, 5Y3/1 very dark grey, few organic specks.

Borehole 88401 G9

Depth (m)	Description
01.00-01.10	**Sand**, fine to medium, 5Y5/1 grey, shell hash, disturbed sample.
01.50-01.54	**Sand**, fine, 5Y5/1 grey, shell fragments.
05.00-05.10	**Sand**, fine with angular gravel, 5Y5/1 grey.
05.10-05.16	**Sand**, fine with trace of gravel, 5Y5/1 grey, shell fragments.
05.16-05.25	**Gravel**, angular.
05.25-05.30	**Clay**, silty with some sand and gravel, 5Y4/2 olive grey.
08.00-08.85	**Clayey Silt**, some sand, trace of fine gravel, 5Y3/2 dark olive grey, fining downcore, some sand partings.
09.00-09.54	**Clayey Silt**, some fine sand, trace of angular gravel, 5Y3/1 very dark grey, very stiff.
14.00-14.60	**Sand**, medium grained, trace of fine and coarse sand, 5Y3/1 very dark grey, some siltier pockets.
17.00-17.12	**Sand**, fine, 5Y3/1 very dark grey.
17.12-17.22	**Sand**, fine, mottled, 5Y3/2 dark olive grey.
21.00-21.14	**Sand**, medium to coarse, trace of fine gravel, 5Y3/2 dark olive grey.
21.14-21.40	**Sand**, medium to coarse with a trace of silt, 2.5Y4/4 and 2.5Y3/2 mottled olive brown and very dark greyish brown.
21.40-21.73	**Sand**, medium to coarse, trace of silt, 21.63-21.73m patch of very dark grey clay and silt.
25.00-25.12	**Sand**, fine to medium sand, 2.5Y4/4 olive brown.
25.12-25.42	**Sand**, medium with a trace of coarse sand, 5Y3/2 dark olive grey, 25.32-25.38m clay patch.
29.00-29.24	**Sand**, coarse, with fine gravel and abundant shell fragments.
33.00-33.25	**Sand**, medium to coarse, minor silt, 5Y3/2 dark olive grey, silty patch 33.15-33.25.
40.00-40.62	**Sand**, medium grained with some silt, slight increase in silt downcore, 5Y3/2 dark olive grey.
45.00-45.12	**Sand**, medium grained, some silt, 5Y3/2 dark olive grey. ($5.11-45.12 cemented?) - sharp lower contact.
45.12-45.53	**Silt**, some fine sand, 5Y4/1 dark grey.
45.53-45.66	**Sand**, silty, fine sand, mottled dark grey and v. dark grey. 5Y3/1, 5Y4/1.
48.00-48.67	**Silt**, some clay, increase clay downcore, stiff, 5Y3/1 very dark grey. 48.59 sand lamina with wood fragment 1 cm above it.

Borehole 88401 G10

Depth (m)	Description
05.00-05.21	**Sand**, medium, with fine to medium gravel and abundant shell fragments, 5Y4/1 dark grey. Large rock from 5.00-5.04 m.
08.05-08.15	**Clay**, sandy, with sub-angular gravel, very stiff, 5Y3/1, very dark grey.
08.50-08.70	**Silt**, slightly sandy with angular cobbles 5-8 cm in length. Most of this sample was gravel and one large cobble, held together by a matrix of very dark grey (5Y3/1) silt.

Borehole 88401 G11

Depth (m)	Description
03.00-03.15	**Sand**, fine to medium, with fine to medium gravel and abundant shell fragments, 5Y4/1 dark grey.
03.80-04.16	**Sand**, fine to medium, with fine to medium gravel and abundant shell fragments increasing in abundance and size downcore, 5Y4/1 dark grey.
07.00-07.21	**Silt**, with clay, fine to medium subrounded to subangular gravel and cobbles, and shell fragments, 5Y3/1 very dark grey. Large rock 7.00-7.03 m.
09.50-***	**Silt**, with fine sand, 5Y3/1 very dark grey (no sample - only what was on outside of tube).
11.00-11.30	**Sand**, medium grained, with fine gravel and abundant shell fragments, 5Y3/2 dark olive grey. Considered to be cuttings.
12.00-12.05	**Sand**, medium grained, with fine gravel and abundant shell fragments, 5Y3/2 darkolive grey.

Borehole 88401 G12

Depth (m)	Description
00.00-02.00	**Sand**, medium with one pebble and shell fragments, 2.5Y5/2, greyish brown (couldn't sample)
03.80-04.26	**Sand**, medium to coarse, with fine gravel and abundant shell fragments, dark grey.= cuttings?

Borehole 88401 G12a

Depth (m)	Description
04.00-04.05	**Gravel**, fine-grained and angular, and cuttings.

04.50-04.60 **Clay**, silty, with trace sand and gravel, 5Y3/1, very dark grey, low plasticity, hard.

05.00-05.15 **Clay**, silty with trace sand and angular gravel, 5Y3/1, very dark grey.

Borehole 88401 G13

Depth (m)	Description
00.00-00.07	**Cobbles**, and fine sand.

Borehole 88401 G14

Depth (m)	Description
05.00-05.03	**Gravel**, and angular rock fragments.
06.00-06.05	**Sand**, coarse, with gravel and shell fragments, with rare clay pockets.
06.05-06.15	**Sand**, coarse, with gravel and shell fragments, in a matrix of fine to medium sand.
06.15-06.28	**Sand**, coarse, with gravel and shell fragments.
07.00-07.04	**Gravel**, with clay, 5Y3/1, very dark grey.
07.04-07.14	**Sand**, fine, muddy, with pebbles, 5Y3/1, very dark grey.
07.14-07.30	**Sand**, fine, muddy and gravelly, 5Y3/1, very dark grey.
08.00-08.20	**Sand**, coarse, muddy, with pebbles and shell debris, 2.5Y4/2, dark greyish brown.
10.00-10.10	**Gravel**, and cobbles. One cobble has some light brown mud.

Borehole 88401 G15

Depth(m)	Description
00.00-00.05	**Sand**, fine and clean, with shell fragments and gravel, 2.5Y3/2, greyish brown.
04.00-04.23	**Sand**, medium, with gravel and shell fragments, N4/0, dark grey. Becomes silty downcore.
09.00-09.08	**Cobble**, wedged in the sampling tube.
09.10-09.15	**Clay**, with sand plastered to the outside of the sample, very dark grey.
13.00-13.??	**Sand**, medium, silty, 5Y3/1, dark grey. Sample is scraped from the bottom of the tube, as it could not be extruded.

Borehole 88401 NEA1

Depth (m)	Description
00.0-00.20	**Sand**, fine, clean, well-rounded to subrounded, with a heavy mineral content apparent <5%, 2.5Y5.5/2, light brownish grey.
04.00-04.07	**Silty clay**, with pebbles and minor amounts of fine sand, very stiff, N3/0, very dark grey.
04.07-04.40	**Sand**, slightly muddy with abundant rounded shell fragments and clayballs, N3/0, very dark grey.
04.40-04.45	**Mud**, slightly sandy, very stiff, 5Y3/1, very dark grey.
05.00-05.10	**Mud**, with coarse sand and gravel and shell hash, 5Y3/1, very dark grey.
05.10-05.23	**Mud**, with rounded pebbles and shell fragments, 5Y3/1, very dark grey.
05.23-05.29	**Gravel**, with pebbles and shell hash.
05.29-05.60	**Mud**, slightly sandy, very stiff, 5Y3/1, very dark grey.
09.00-09.85	**Mud**, slightly sandy, decrease silt and sand downcore, N3/0, very dark grey.
13.00-13.10	**Sand**, with clayballs, 5Y3/1, very dark grey, probably wash-in.
13.10-13.45	**Sand**, slightly silty, 5Y4/2, dark olive grey.
13.45-13.55	**Sand**, very loose, 2.5Y3/2, very dark greyish brown.
17.00-17.92	**Sand**, silty, grading downward to muddy sand, very stiff, 5Y3/1, very dark grey.
21.00-21.57	**Sand**, silty with occasional pebbles and clayballs, grading to a less silty medium sand at the base, 5Y3/1, very dark grey.
25.00-25.23	**Sand**, slightly muddy, 2.5Y3/2, dark greyish brown.
29.00-29.36	**Sand**, medium, slightly muddy, grading to a slightly muddy coarse sand downcore, 2.5Y3/2, very dark greyish brown.
33.00-33.31	**Sand**, slightly muddy, 2.5Y3/2, very dark greyish brown.
33.31-33.38	**Sand**, slightly muddy, 2.5Y4/2, dark greyish brown.

Borehole 88401 NEA2

Depth (m)	Description
06.00-06.65	**Sand**, very coarse, slightly muddy with crushed shell fragments and some fine sand, very dark grey.
06.65-06.70	**Sand**, fine, slightly muddy, very dark grey.
07.00-07.15	**Gravel**, slightly muddy, probably wash.
07.15-07.22	**Sand**, fine, silty, with pebbles, 5Y2.5/1, very dark grey.
07.22-07.30	**Sand**, fine, silty, 5Y2.5/1, very dark grey, stiff.
08.00-08.05	**Sand**, fine, silty and gravelly, 5Y3/1, very dark grey.
08.05-08.26	**Sand**, fine, silty, well-sorted, with rare shell fragments, 5Y3/1, very dark grey.
09.00-09.50	**Mud**, sandy, 5Y2.5/1, very dark grey.
09.50-09.65	**Mud**, very stiff, 5Y2.5/1, very dark grey.
10.00-10.08	**Clay**, some silt with trace sand, 5Y2.5/1, very dark grey.
10.08-10.73	**Clay**, with sand and silt, 5Y2.5/1, very dark grey.
10.73-10.83	**Clay**, slightly silty, 5Y2.5/1, very dark grey.
11.00-11.94	**Clay**, with silt, 5Y2.5/1, very dark grey.
12.00-12.48	**Clay**, very stiff, 5Y3/1, very dark grey, rare shell fragments.
12.48-12.59	**Clay**, with sand and silt, 5Y3/1, very dark grey.
12.59-12.85	**Clay**, sandy, grading downwards into muddy sand, 5Y3/1, very dark grey.
12.85-12.96	**Sand**, fine, muddy, coarsening downward to medium sand, 5Y3/1, very dark grey.
13.00-13.07	**Clay**, slightly silty, 5Y2.5/1, very dark grey.
13.07-13.37	**Sand**, slightly muddy, coarsening downcore, with occasional spots of organic detritus (wood fragments) and a clay lump (gypsum?), 5Y3/2, dark olive-grey.
13.37-13.65	**Sand**, medium, silty, with clay lamina, 5Y2.5/1, very dark grey.
13.65-13.69	**Sand**, coarse, slightly muddy, 5Y3/2, dark olive-grey.
13.69-13.82	**Sand**, slightly muddy, 5Y2.5/1, very dark grey.

Borehole 88401 NEA3

Depth (m)	Description
03.00-03.32	**Gravel**, sandy and silty, shell hash, very dark grey.
04.00-04.11	**Gravel**, shelly with coarse sand and silty lumps, very dark grey.
08.00-08.14	**Silt**, slightly sandy, with subrounded pebbles, 5Y3/1, very dark grey, very stiff.
12.00-12.19	**Mud**, very stiff, 5Y3/1, very dark grey.

Borehole 88401 SEA1

Depth (m)	Description
03.00-03.12	**Sand**, fine, silty, with shell fragments, 5Y3/1, very dark grey.
03.12-03.17	**Sand**, coarse, with gravel and shell hash.
03.17-03.30	**Clay**, sandy, 5Y3/1, very dark grey., sharp upper contact.
04.00-04.10	**Cobbles**, with gravel and pebbles, and one clayball.
10.00-10.12	**Clay**, sandy, 5Y3/1, very dark grey.
10.12-10.17	**Clay**, gravelly, 5Y3/1, very dark grey.
10.17-10.55	**Clay**, sandy, 5Y3/1, very dark grey, grading downwards to a fine clayey sand.
10.55-10.59	**Sand**, fine, muddy, with coarse sand and degraded woody fragments, 2.5Y3/2, very dark greyish brown.
10.59-10.91	**Sand**, fine, silty, with medium sand, 5Y3/1, very dark brown.
12.00-12.18	**Sand**, medium, silty, with organic specs, 5Y3/1, very dark grey.
12.18-12.50	**Sand**, medium, silty, 2.5Y3/2, dark greyish brown.
12.50-12.71	**Sand**, medium, silty, 5Y3/1, very dark grey.
15.00-15.52	**Sand**, fine to medium, slightly muddy, 5Y3/2, very dark olive grey.

Borehole 88401 SEA2

Depth (m)	Description
00.00-00.20	**Sand**, with shell fragments, 2.5Y3/2, light greyish brown.
01.00-01.10	**Sand**, 5Y3/1, very dark grey.
01.10-01.25	**Sand**, medium, with gravel and abundant shell fragments, 5Y3/1, very dark grey.
02.00-02.20	**Gravel**, with sand, and abundant shell fragments.
03.00-03.17	**Sand**, fine, with pebbles and shell fragments, dark grey.
03.17-03.28	**Sand**, coarse and fine, with gravel and shell fragments.
04.00-04.06	**Sand**, fine, 5Y3/1, very dark grey.
04.06-04.25	**Sand**, medium, with gravel and shell fragments, 5Y3/1, very dark grey.
05.00-05.10	**Gravel**, coarse, with abundant shell debris.
05.10-05.21	**Gravel**, medium, sandy, with shell debris.
05.21-05.38	**Gravel**, coarse, with shell debris.
06.00-06.12	**Clay**, with gravel and pebbles, 5Y3/1, very dark grey.
06.12-06.45	**Clay**, 5Y3/1, very dark grey, very stiff.
06.45-06.55	**Clay**, sandy, 5Y3/1, very dark grey, very stiff.
07.00-07.05	**Clay**, with one large diorite cobble, 5Y3/1, very dark grey.
08.00-08.07	**Clay**, sandy, 5Y2.5/1, very dark grey.
08.07-08.20	**Clay**, 5Y2.5/1, very dark grey, stiff.
08.50-08.72	**Clay**, silty, with trace gravel, very dark grey.
08.72-08.95	**Clay**, badly deformed by a large cobble.
09.00-09.48	**Clay**, N3/0, very dark grey, very stiff.
09.48-09.60	**Clay**, sandy, N3/0, very dark grey, stiff.
12.00-12.54	**Sand**, fine, with pockets of brown sand, 5Y3/1, very dark grey.
16.00-16.30	**Sand**, fine, silty, very dark grey.
16.30-16.55	**Sand**, coarse, with pockets of dark grey clay, brown.

16.55-16.63	**Sand**, fine, with pockets of dark grey clay, very dark grey.
20.00-20.12	**Sand**, muddy, with clay pockets, 5Y3/2, very dark olive grey.
20.12-20.42	**Sand**, fine, muddy, with <10% coarse sand, 5Y3/2, very dark olive grey.
24.00-24.05	**Sand**, fine, silty, with clay pockets and pockets of coarse brown sand, very dark grey.
24.05-24.17	**Sand**, coarse, brown.
24.17-24.40	**Sand**, fine, silty, with sandy and clayey pockets, very dark grey.
28.00-28.17	**Sand**, medium to coarse, with dark grey clay pockets, 2.5Y3/2, dark greyish brown.
28.17-28.25	**Sand**, with thin laminations of clay.
28.25-28.32	**Sand**, coarse, 2.5Y3/2, dark greyish brown.
32.00-32.30	**Sand**, medium, slightly muddy, with clay pockets, and coarse brown sand pockets, 5Y3/2, dark grey.
32.30-32.49	**Sand**, medium, with brownish coarse sand and clay pockets, 5Y3/1, very dark grey.
36.00-36.10	**Sand**, medium, muddy, 5Y3/2, dark olive grey.
36.10-36.38	**Sand**, fine, with pockets of medium light brown sand, 5Y3/2, dark olive grey.

Borehole 88401 SEA3

Depth (m)	Description
00.00-00.10	**Sand**, fine to medium, with shell fragments, 7.5YR5/2, light brown.
01.00-01.10	**Sand**, medium, muddy, with pebbles and shell fragments, N3/0, very dark grey.
01.10-01.20	**Gravel**, sandy, with shell hash.
02.00-02.29	**Gravel**, sandy, with shell hash, with <5% fine muddy sand.
02.29-02.30	**Mud**, slightly sandy, very dark grey.
06.00-06.05	**Mud**, sandy, with shell hash, 5Y3/1, very dark grey.
06.05-06.25	**Mud**, slightly sandy, with occasional shell fragments and gravel, 5Y3/1, very dark grey.

06.25-06.37 **Sand**, fine, muddy, 5Y3/1, very dark grey.

07.00-07.15 **Silt**, sandy, with cobbles, gravel, and shell fragments, 5Y2.5/1, very dark grey.

07.50-08.11 **Clay**, slightly sandy and gravelly, 5Y3/1, very dark grey.

08.50-09.30 **Clay**, slightly sandy, remoulded by a large cobble jammed during extrusion. Sample became silty sand downcore.

12.50-13.00 **Sand**, medium, with coal fragments and occasional brown muddy bands and mottling, 5Y3/1, very olive dark grey.

13.00-13.16 **Sand**, fine, 5Y3/1, very dark olive grey.

16.00-16.59 **Sand**, slightly muddy, 2.5Y3/2, olive grey.

16.59-16.80 **Sand**, muddy, 2.5Y3/2, olive grey.

19.00-19.25 **Sand**, medium, silty, coarsening downward, 2.5Y3/2, dark olive grey.

19.25-19.43 **Sand**, medium to coarse, with dark grey (5Y3/1) clay pockets, 2.5Y3/2, dark olive grey.

19.43-19.77 **Sand**, medium to coarse, 2.5Y3/2, dark olive grey.

23.00-23.30 **Sand**, medium, slightly silty, with some coarse sand, 5Y3/2, olive grey.

23.30-23.45 **Sand**, medium, slightly silty, with coarse sand, and large clayballs, 5Y3/2, olive grey.

23.45-23.55 **Sand**, medium, with very few clayballs, 5Y3/2, olive grey.

27.00-27.05 **Sand**, very coarse, 10YR3/2, dark brown.

27.05-27.15 **Sand**, with occasional dark grey clayballs, 2.5Y3/2, dark olive grey.

27.15-27.40 **Clay**, slightly sandy, with laminae of clay, dark grey.

27.40-27.52 **Sand**, medium, with clayballs, 5Y3/2, dark olive grey.

Borehole 88401-022

Depth (m)	Description

11.50-11.85 **Clay**, silty, very stiff, 5Y2.5/1, very dark grey.

11.85-11.90 **Silt**, sandy, 5Y2.5/1, very dark grey.

11.90-12.25 **Clay**, silty, very stiff, 5Y2.5/1, very dark grey.

12.25-12.30 **Mud**, silty, 5Y2.5/1, very dark grey.

APPENDIX A

Cruise 88401
Sediment Subsample Summary

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PH - photograph
PM - palaeomagnetics
VE - velocity measurement
FS - foram subsample
BD - bulk density
WC - water content
GS - grain size
XR - x-ray subsample
SH - shells
AT - atterberg limits
CO - consolidation
TOC - total organic carbon

Borehole 88401 G1

Sample No.	Depth Interval (metres)	Subsamples
1	0.0-0.03	PH,GS
2	1.0-1.05	PH,GS
3	1.5-1.70	PH,GS
4	2.0-2.19	PH,GS
5	3.0-3.20	PH,FS
6	5.0-5.27	PH,GS
7	6.0-6.20	PH,WC
8	7.0-7.01	
9	7.5-7.88	PH,VE,FS,XR
10	8.0-8.20	PH,FS,GS
11	10.0-10.77	PH,FS,XR
12	11.0-11.50	PH,GS
13	12.0-12.50	PH,GS,XR,TOC
14	13.0-13.84	PH,XR
15	15.0-15.54	PH,GS
16	16.0-16.47	PH,XR,SH
17	17.0-17.84	PH,XR
18	18.0-18.92	PH,XR,GS
19	19.0-19.64	PH,XR
20	21.0-21.86	PH
21	22.0-22.86	PH,XR
22	23.0-23.32	PH,GS
23	24.0-24.45	PH,GS,XR,SH
24	27.0-27.27	PH

125	28.0-28.38	PH
26	29.0-29.38	PH,GS
27	32.0-32.60	PH,GS,SH
28	33.0-33.33	PH
29	35.0-35.24	PH,XR
30	37.0-37.27	PH,XR
31	38.0-38.28	PH,XR,GS
32	41.0-41.51	PH,XR
33	42.0-42.61	PH
34	45.0-45.87	PH,XR
35	46.0-46.56	PH, FS, WC, PM, XR,GS

Borehole 88401 G1A

Sample No.	Depth Interval (metres)	Subsamples
1	48.0-48.64	PH,GS,FS,BD,WC, PM,VE,XR
2	49.0-49.89	PH,GS,PM,BD,WC, FS,XR,VE
3	52.0-52.60	PH,XR
4	53.0-53.89	PH,VE,XR,PM,BD, WC,FS,GS
5	56.0-56.17	PH
6	57.0-57.30	PH,GS
7	59.0-59.11	PH,GS
8	59.11-59.41	PH
9	61.0-61.20	PH,GS
10	64.0-64.35	PH,GS
11	65.0-65.45	PH,GS
12	66.0-66.18	PH
13	69.0-69.50	PH,XR,FS,BD,WC, GS
14	70.0-70.73	PH,TOC,WC,XR
15	72.0-72.07	PH
16	73.0-73.18	PH,TOC,SH
17	76.0-76.42	PH
18	77.0-77.39	PH
19	80.0-80.39	PH,XR,GS,AT,FS, WC
20	81.0-81.48	PH,GS,WC
21	84.0-84.80	PH,VE,FS,BD,WC, PM,TOC,GS,XR
22	85.0-85.90	PH,VE,FS,BD,WC, PM,GS,XR
23	88.0-88.94	PH,CO,VE,XR,BD,

		WC,PM,FS,GS
24	89.0-89.90	PH,CO,VE,FS,BD, WC,PM,XR
25	92.0-92.90	PH,VE,XR,PM,BD, WC,GS
26	93.0-93.87	PH,VE,BD,WC,PM, FS,GS,XR
27	96.0-96.82	PH,VE,XR,PM,FS, BD,WC,GS
28	97.0-97.92	PH,VE,XR,FS,PM, BD,WC,GS
29	100.0-100.715	PH,XR,FS,BD,WC, PM
30	101.0-101.89	PH,XR,PM,FS, BD,WC,GS
31	104.0-104.89	PH,XR,PM,FS,BD, WC,GS
32	105.0-105.71	PH,XR,GS
33	109.0-109.90	PH,XR,FS,PM,BD, WC,GS
34	113.0-113.84	PH,GS
35	114.0-114.85	PH
36	118.0-118.84	PH,XR

Borehole 88401 G2

Sample No.	Depth Interval (metres)	Subsamples
1	0.0-0.10	PH
2	1.0-1.32	PH

Borehole 88401 G2A

Sample No.	Depth Interval (metres)	Subsamples
1	10.0-10.02	PH
2	10.5-10.52	PH
3	14.0-14.44	PH,GS
4	18.0-18.10	PH
5	22.0-22.30	PH,GS,SH
6	26.0-26.37	PH,GS
7	30.0-30.20	PH,GS
8	34.0-34.25	PH
9	40.0-40.30	PH,GS
10	44.0-44.94	PH,GS,PM,XR
11	48.0-48.96	PH,CO,AT,VE,XR, FS,BD,WC,PM,GS

Borehole 88401 G3

Sample No.	Depth Interval (metres)	Subsamples
1	5.0-5.35	PH
2	5.5-6.03	PH,FS,BD,WC,XR, VE,GS,AT,PM

Borehole 88401 G4

Sample No.	Depth Interval (metres)	Subsamples
1	3.0	
2	7.0-7.15	PH
3	8.0-8.30	PH,GS,FS

Borehole 88401 G5

Sample No.	Depth Interval (metres)	Subsamples
1	3.0-3.14	PH,GS

Borehole 88401 G6

Sample No.	Depth Interval (metres)	Subsamples
1	3.0-3.47	PH,GS
2	7.0-7.10	PH
3	8.0-8.08	PH

Borehole 88401 G7

Sample No.	Depth Interval (metres)	Subsamples
1	0.0-0.12	PH,GS
2	7.0-7.20	PH,GS
3	11.0-11.46	PH,GS,XR
4	15.0-15.16	PH,GS
5	19.0-19.57	PH,GS
6	24.0-24.40	PH,GS,XR
7	28.0-28.40	PH,GS

8	32.0-32.40	PH,GS
9	36.0-36.24	PH,GS

Borehole 88401 G8

Sample No.	Depth Interval (metres)	Subsamples
1	2.0-2.07	PH
2	6.0-6.20	PH,GS
3	11.0-11.43	PH,XR
4	16.5-16.52	PH
5	20.0-20.95	PH,GS,FS
6	25.0-25.13	PH
7	29.0-29.22	PH,GS
8	33.0-33.40	PH,GS,XR,WC
9	37.0-37.15	PH,GS
10	42.0-42.42	PH,GS
11	46.0-46.81	PH,XR

Borehole 88401 G9

Sample No.	Depth Interval (metres)	Subsamples
1	1.0-1.10	PH
2	1.5-1.54	PH
3	5.0-5.10	PH
4	5.1-5.30	PH
5	8.0-8.85	PH,XR,GS
6	9.0-9.54	PH,FS,GS
7	14.0-14.60	PH,GS
8	17.0-17.22	PH,GS
9	21.0-21.73	PH,XR,GS
10	25.0-25.42	PH
11	29.0-29.30	PH,GS
12	33.0-33.35	PH,GS

Borehole 88401 G10

Sample No.	Depth Interval (metres)	Subsamples
1	5.0-5.21	PH,GS

Borehole 88401 G11

Sample No.	Depth Interval (metres)	Subsamples
1	3.0-3.15	PH,GS,SH
2	3.8-4.16	PH,GS,SH
3	7.0-7.21	PH,GS
4	9.5-	
5	11.0-11.30	PH,GS,SH
6	12.0-12.05	PH

Borehole 88401 G12

Sample No.	Depth Interval (metres)	Subsamples
1	0.0-0.02	PH
2	3.8-4.26	PH,GS,SH

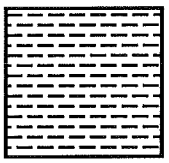
Borehole 88401 G12A

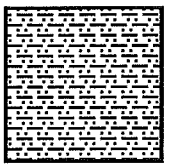
Sample No.	Depth Interval (metres)	Subsamples
1	4.0-4.05	PH
2	4.5-4.60	PH
3	5.0-5.15	PH

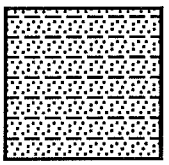
APPENDIX A

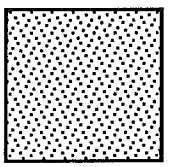
Graphic Columns

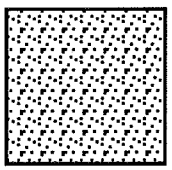
LEGEND

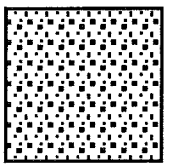

SILTY CLAY

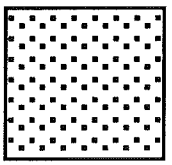

SANDY SILT

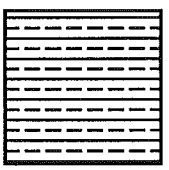

SILTY SAND

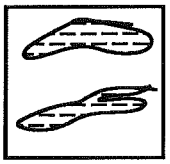

FINE SAND

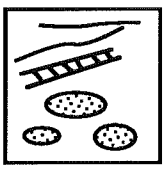

FINE TO MEDIUM SAND

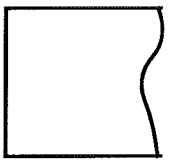

MEDIUM TO COARSE SAND

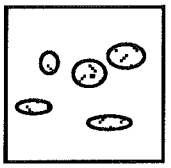

COARSE SAND


ORGANIC SILT

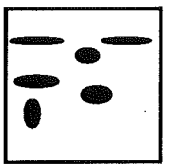

MOTTLES

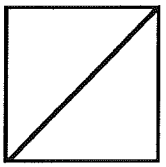

BURROWS, TRACES, & BURROW INFILLING

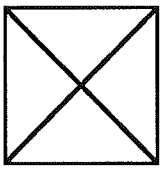

"LOOSE" SEDIMENT IN CORE


PEBBLES


SHELL FRAGMENTS


ORGANICS


CONSOLIDATION SAMPLE


DRILLING VOID

LEGEND (continued)

classification sample

grain size

X-radiograph

velocity

bulk density

water content

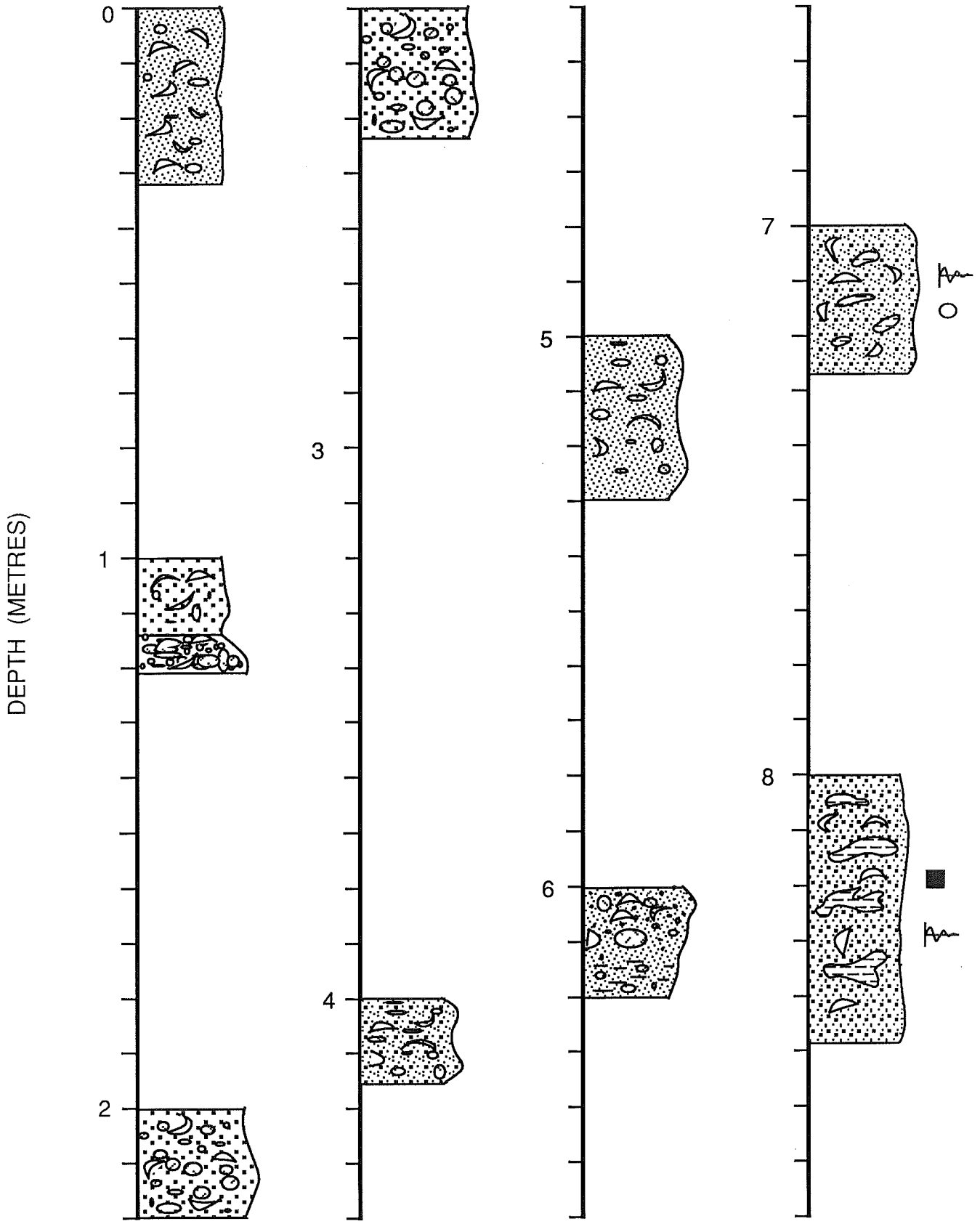
paleomagnetic

foraminifera

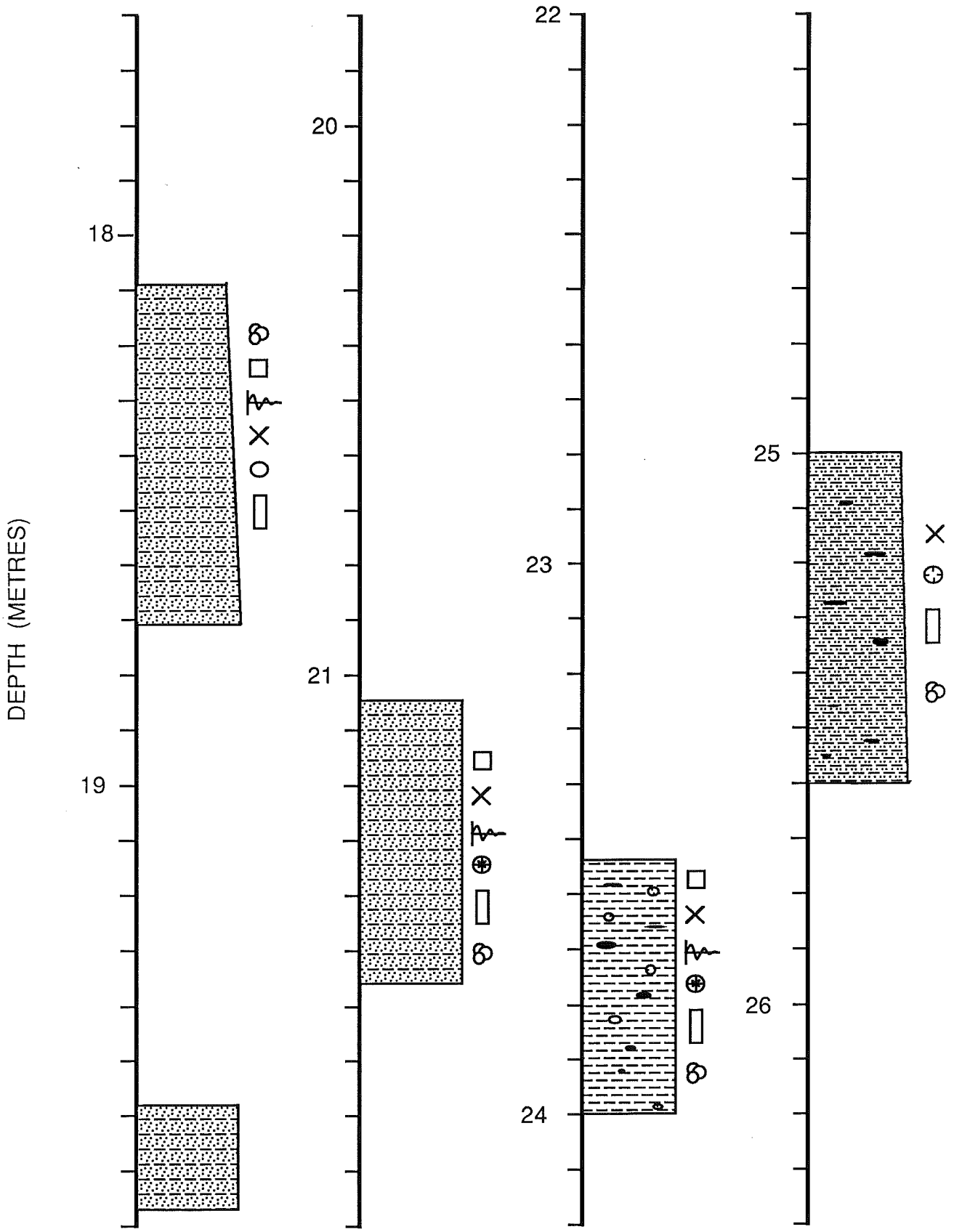
clear  = subsample taken

filled-in  = subsample analysed

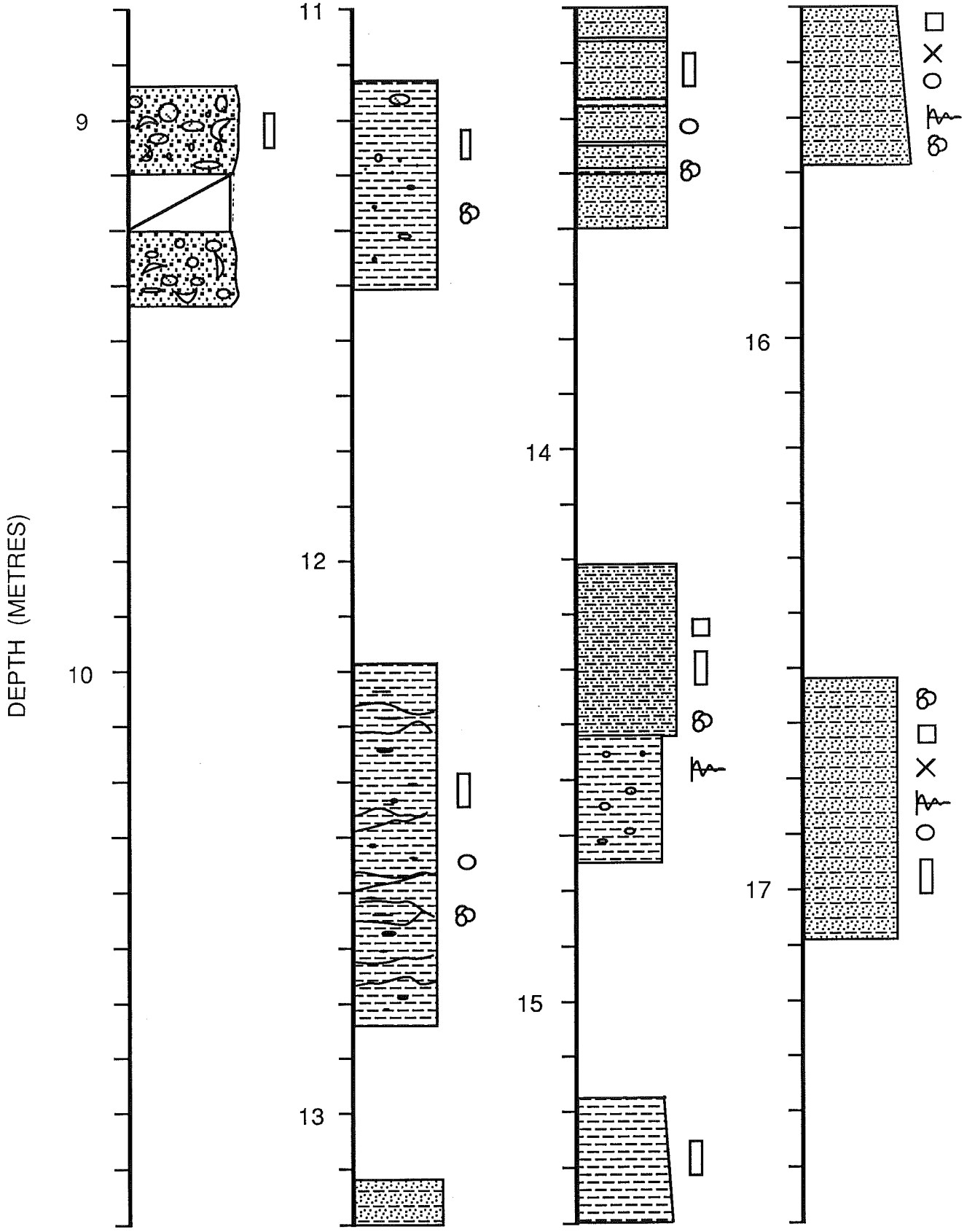
88400-01 Terra Nova



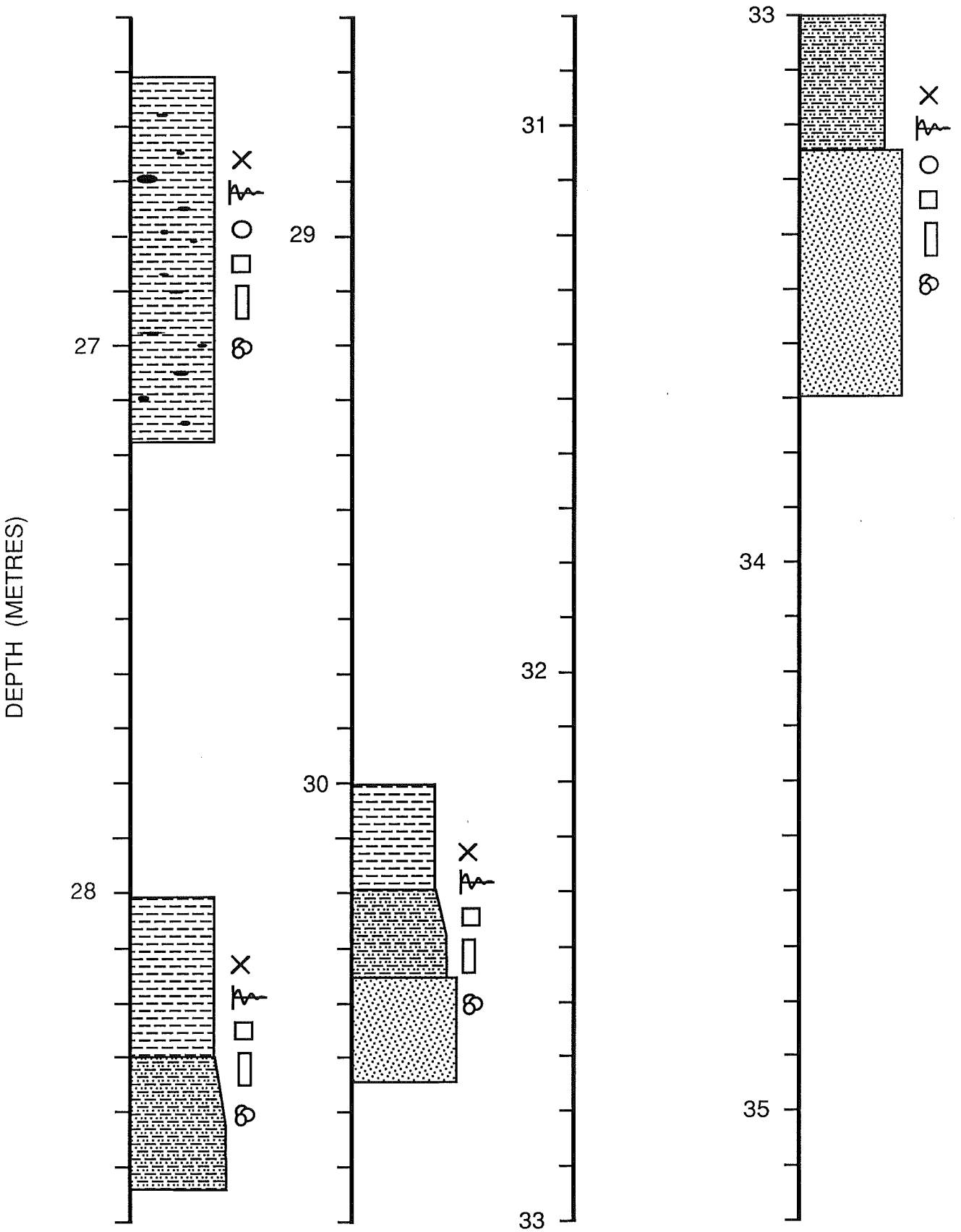
88400-01 Terra Nova



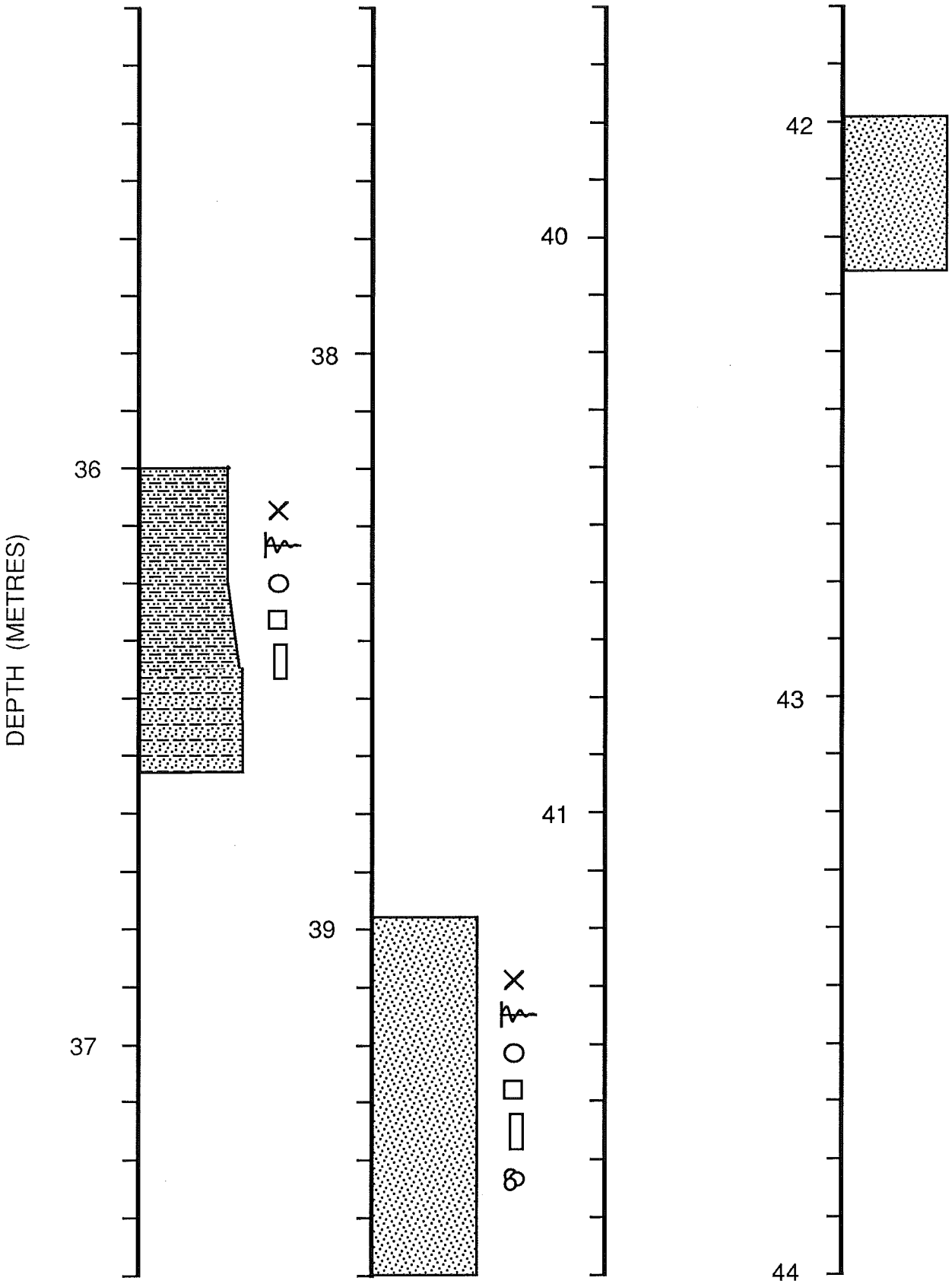
88400-01 Terra Nova



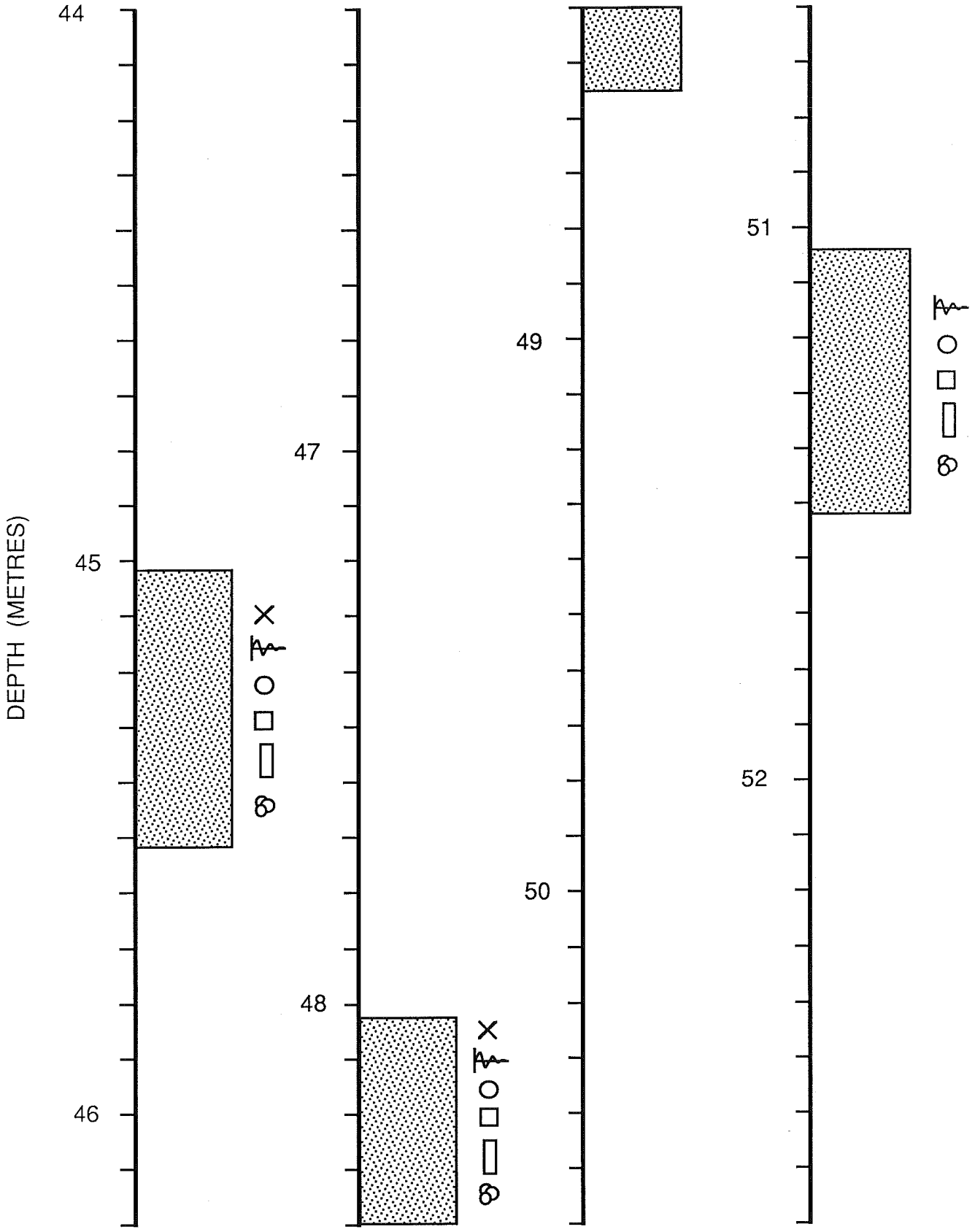
88400-01 Terra Nova



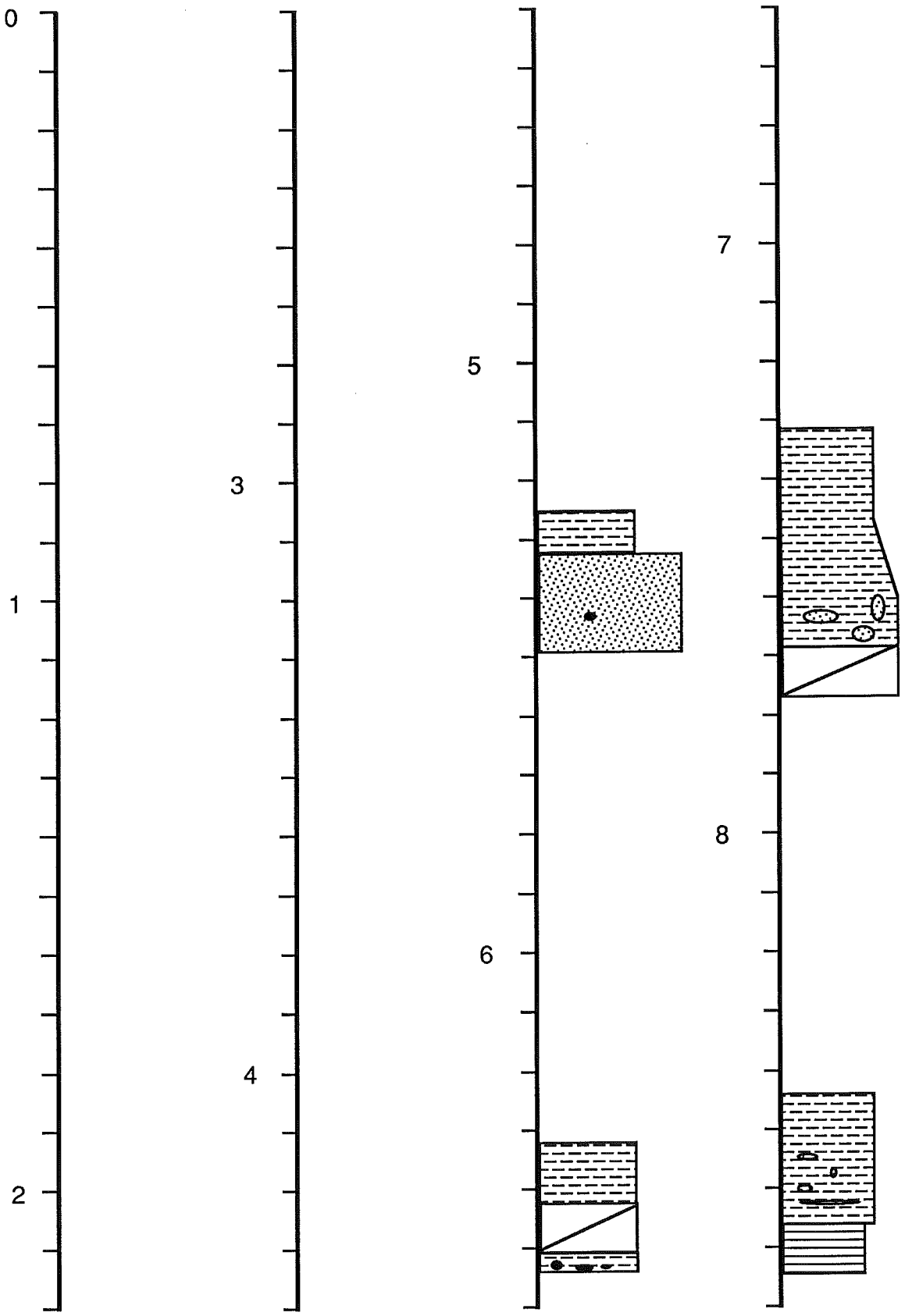
88400-01 Terra Nova



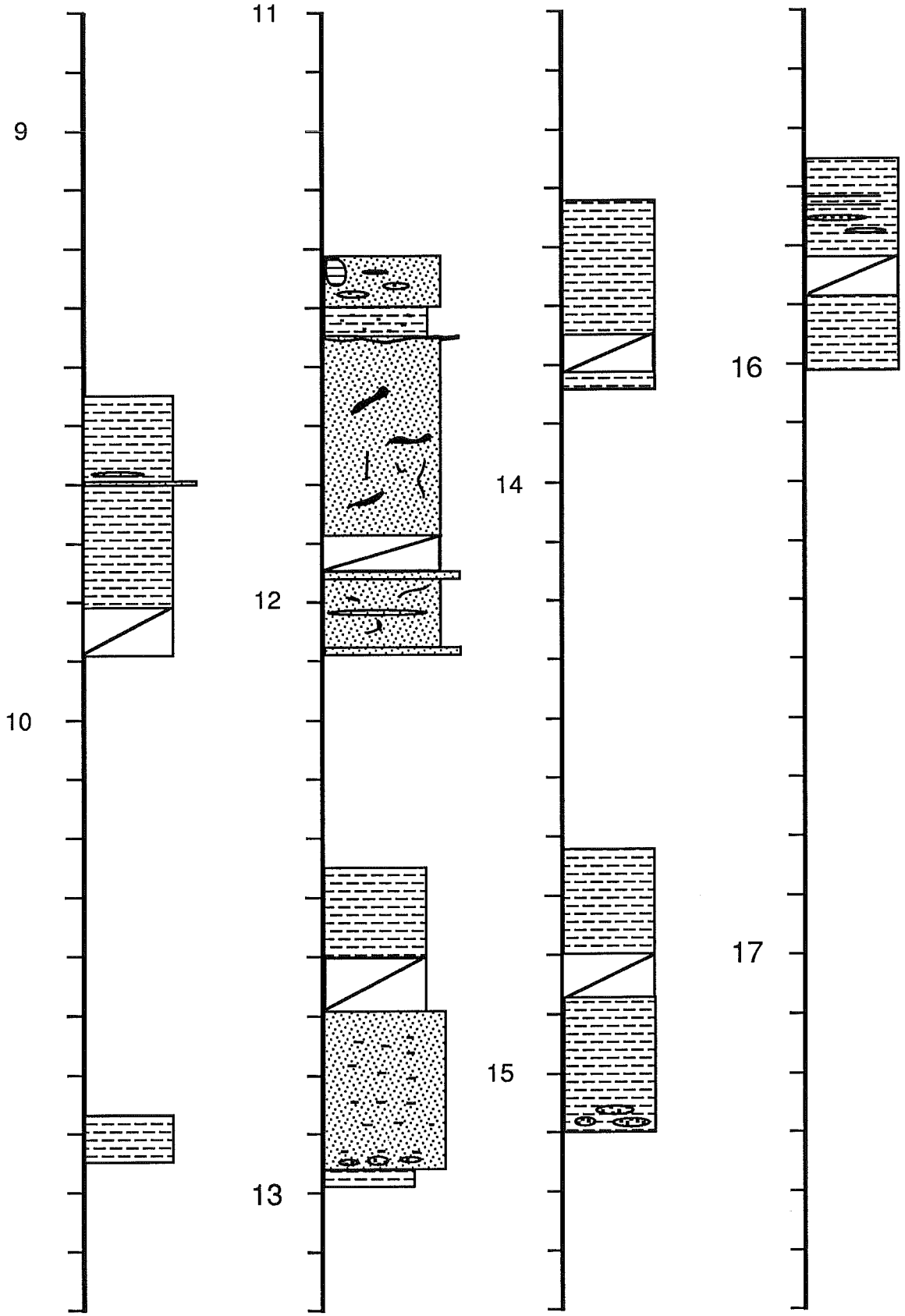
88400-06 Bowers Pit



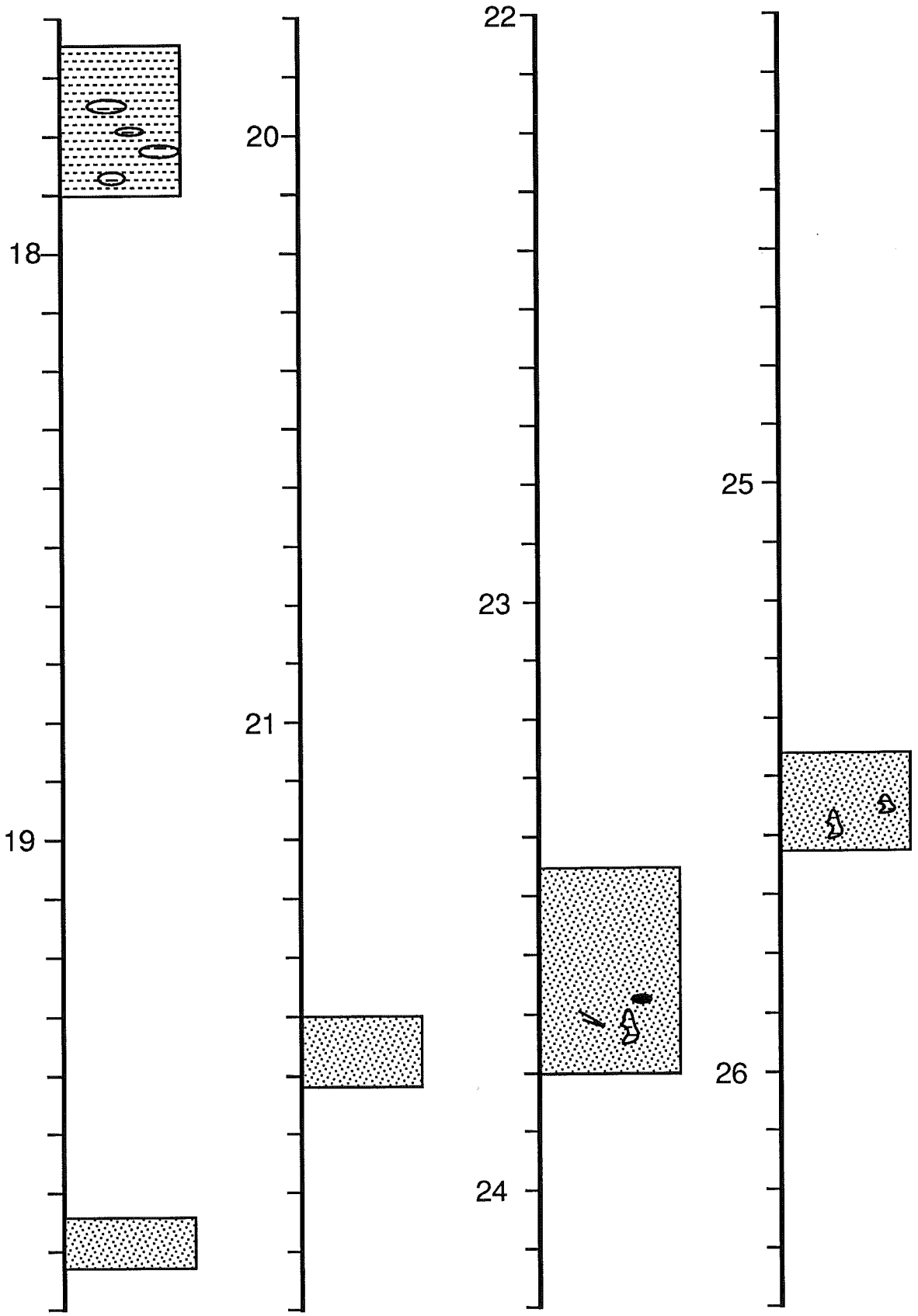
88400-06 Bowers Pit



88400-06 Bowers Pit



88400-06 Bowers Pit



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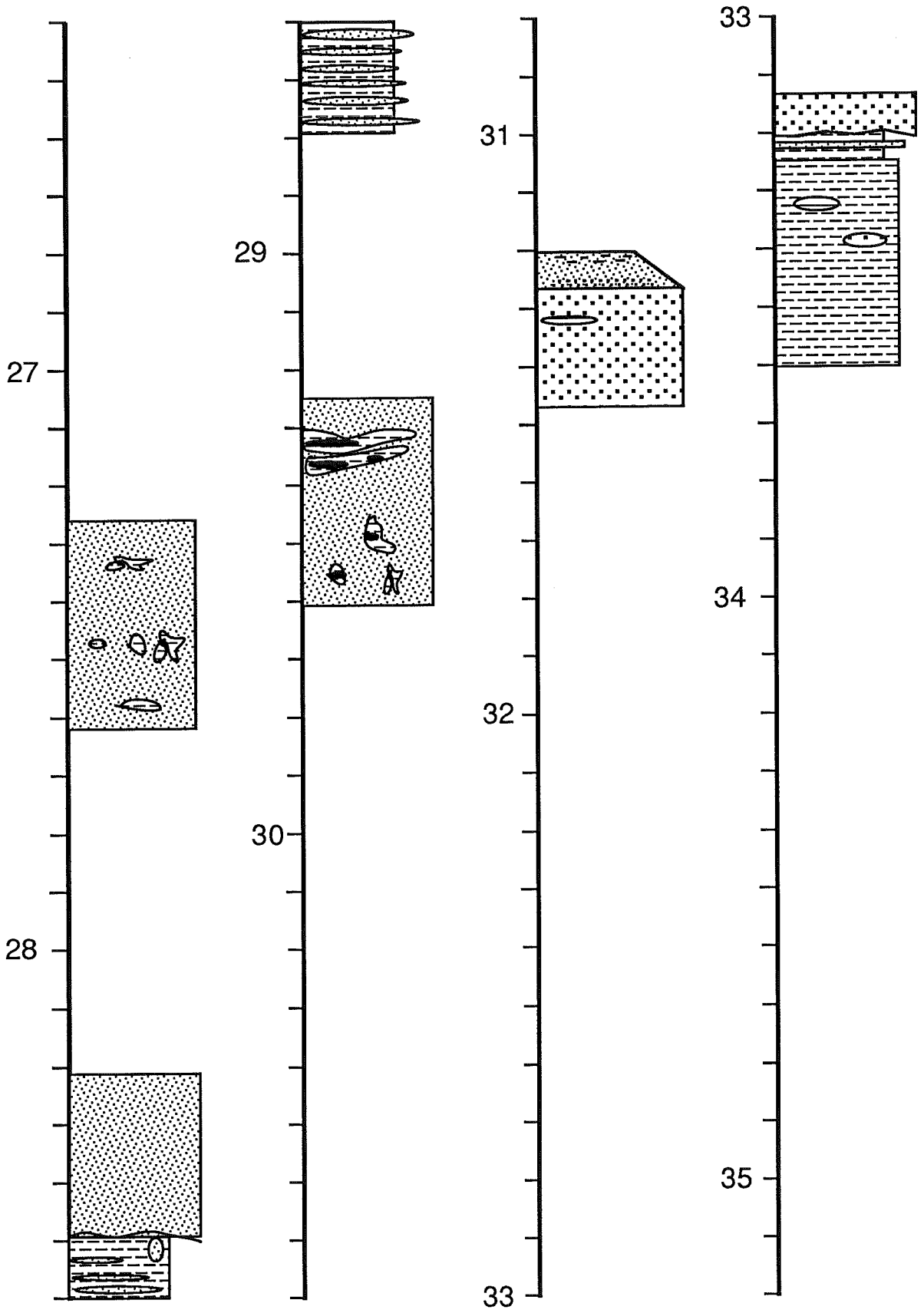

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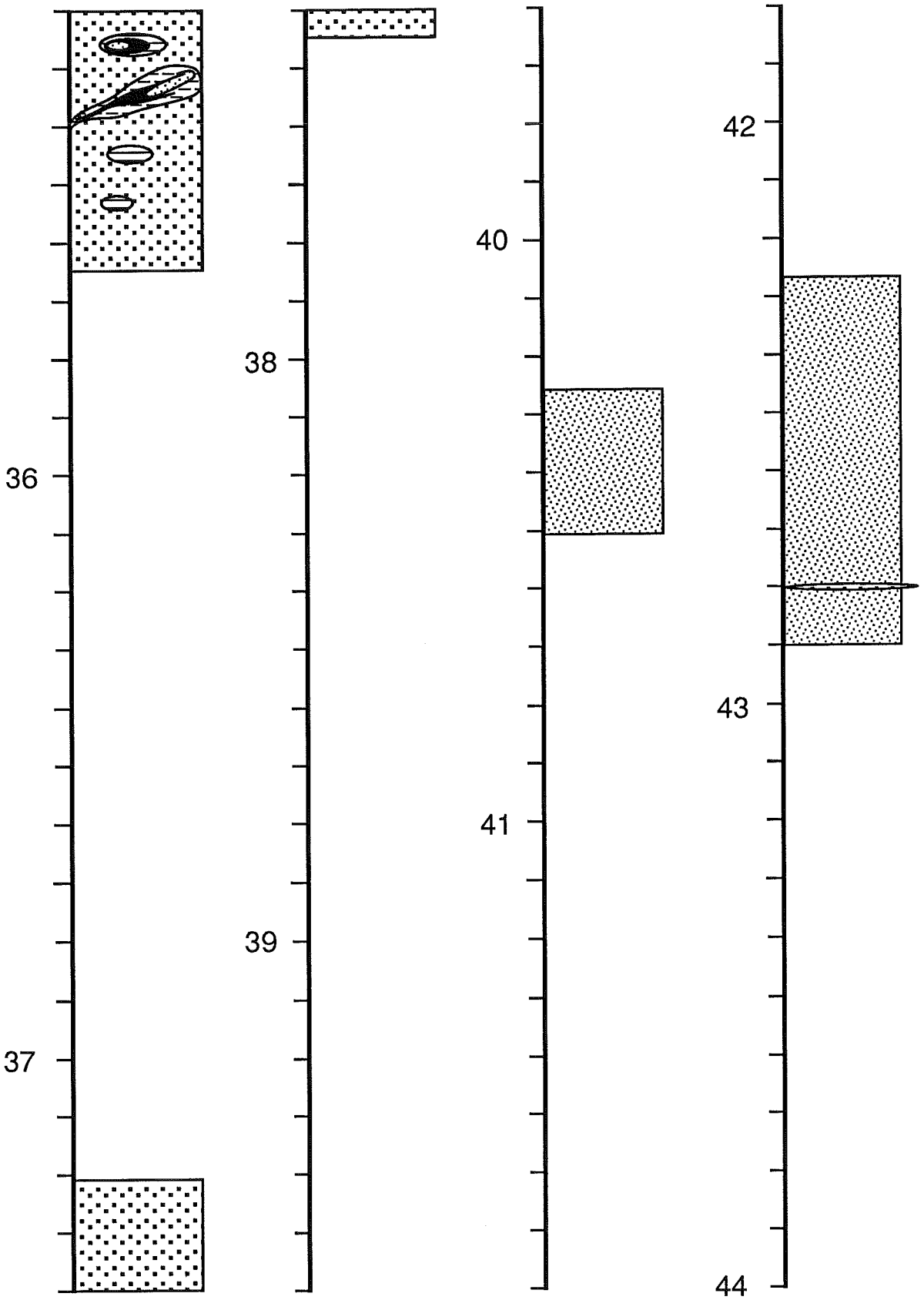

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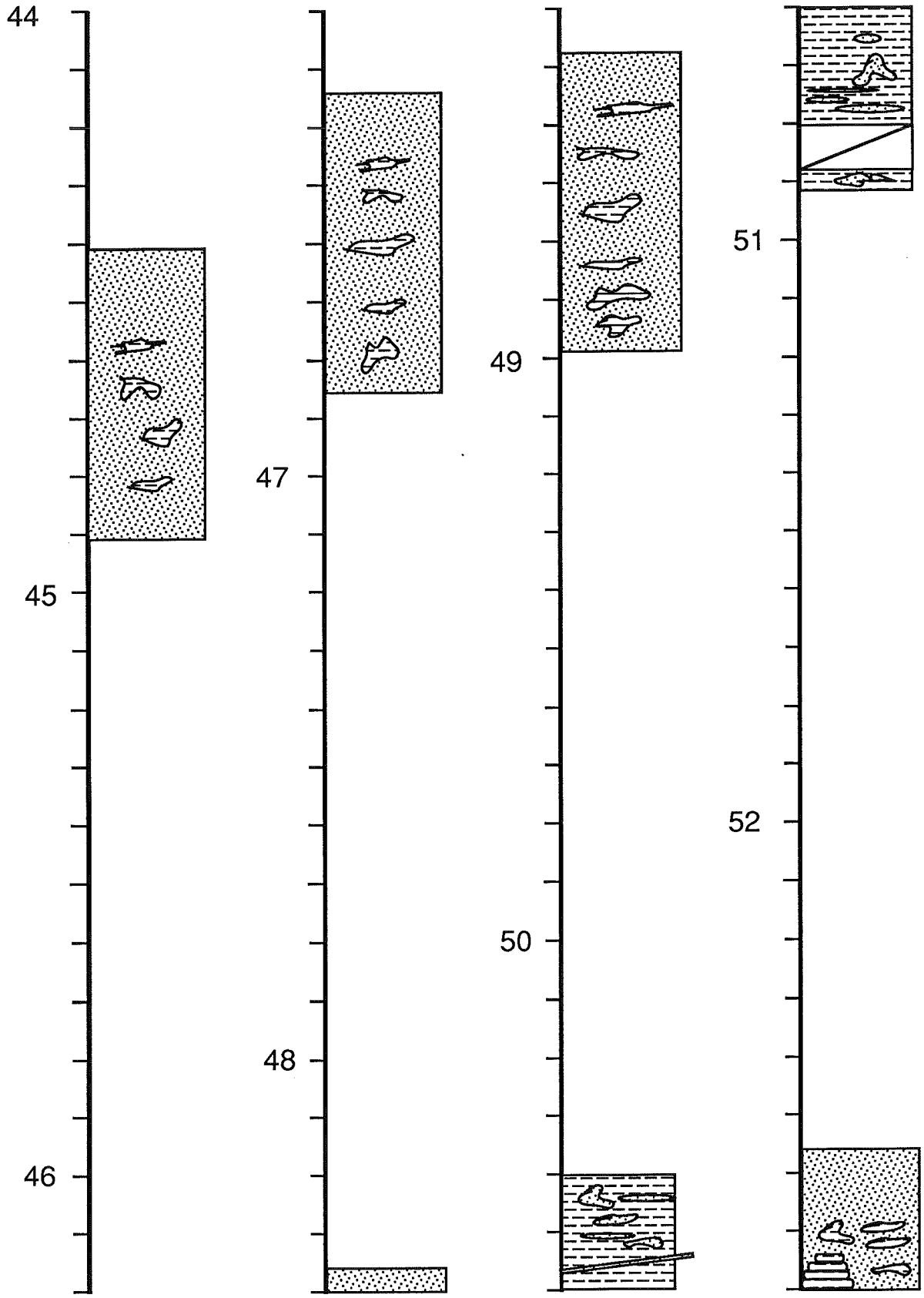

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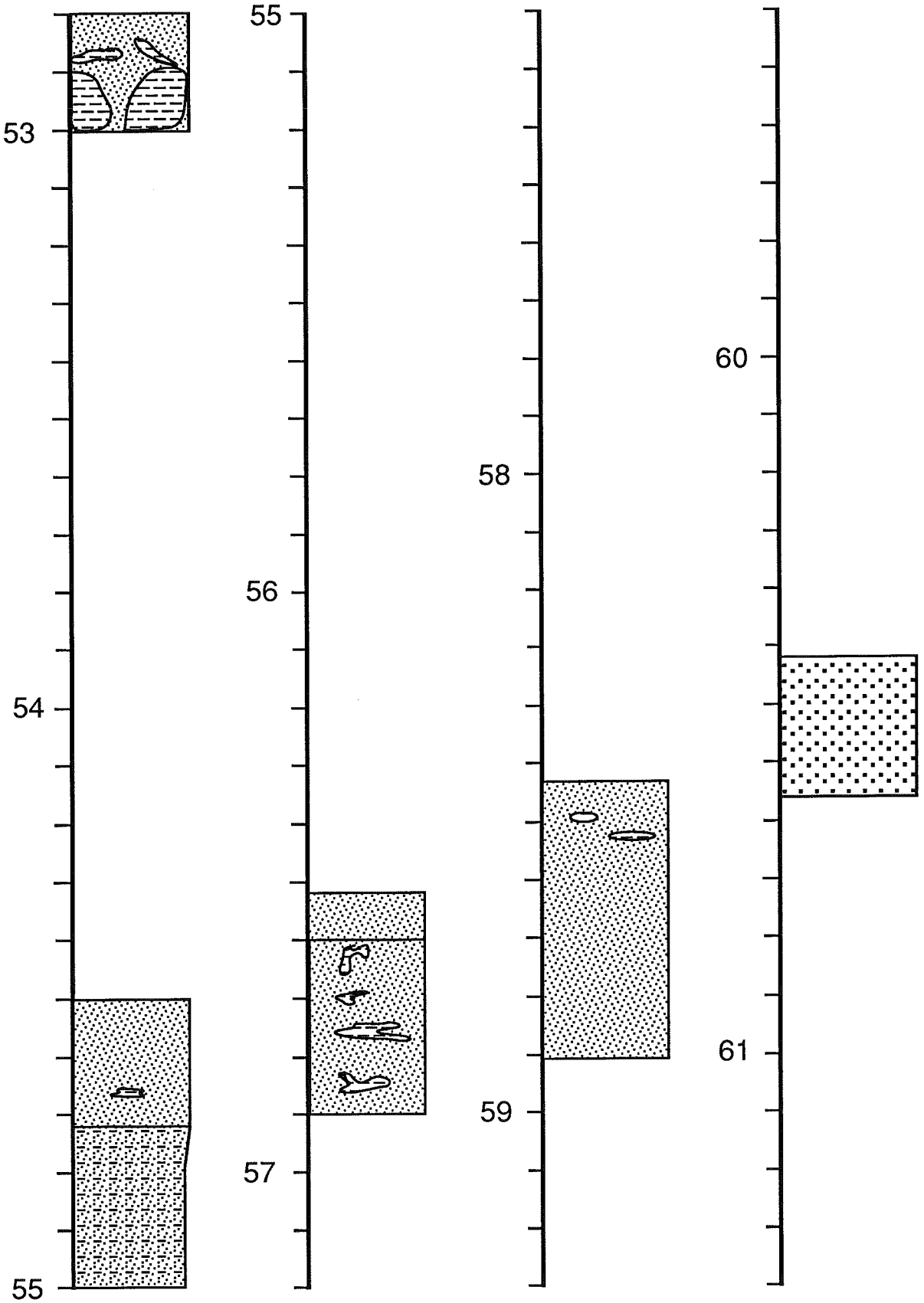

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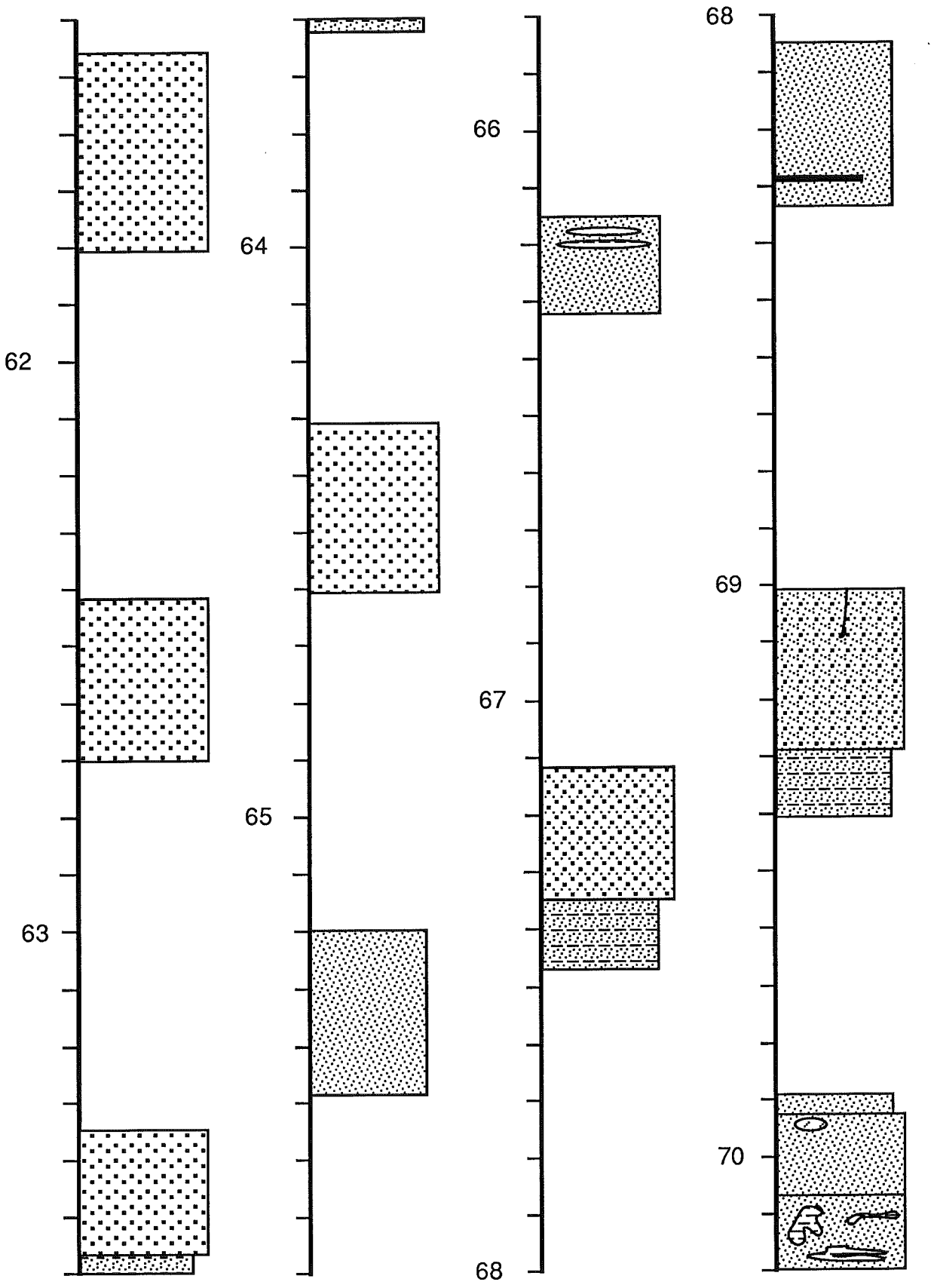

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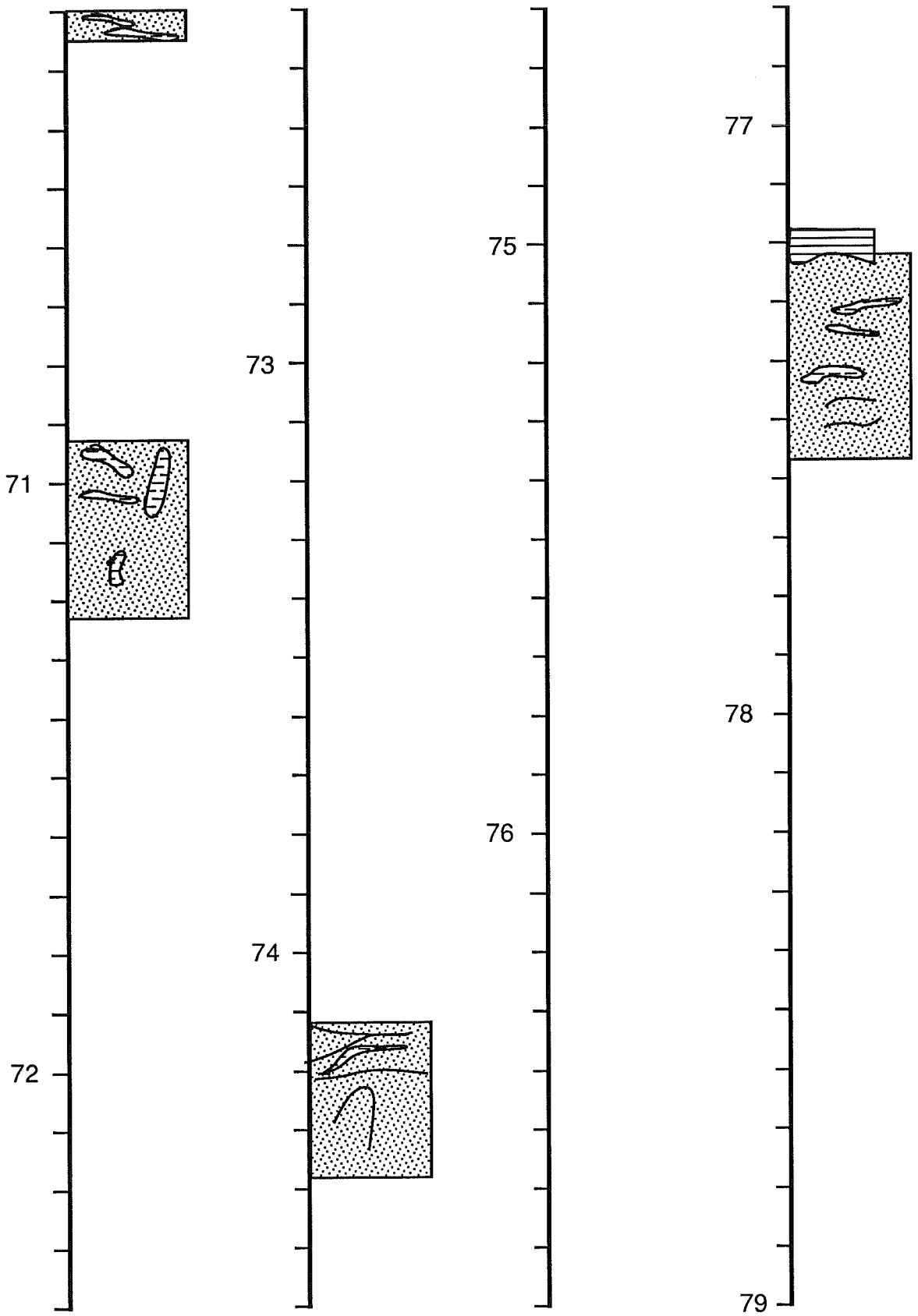

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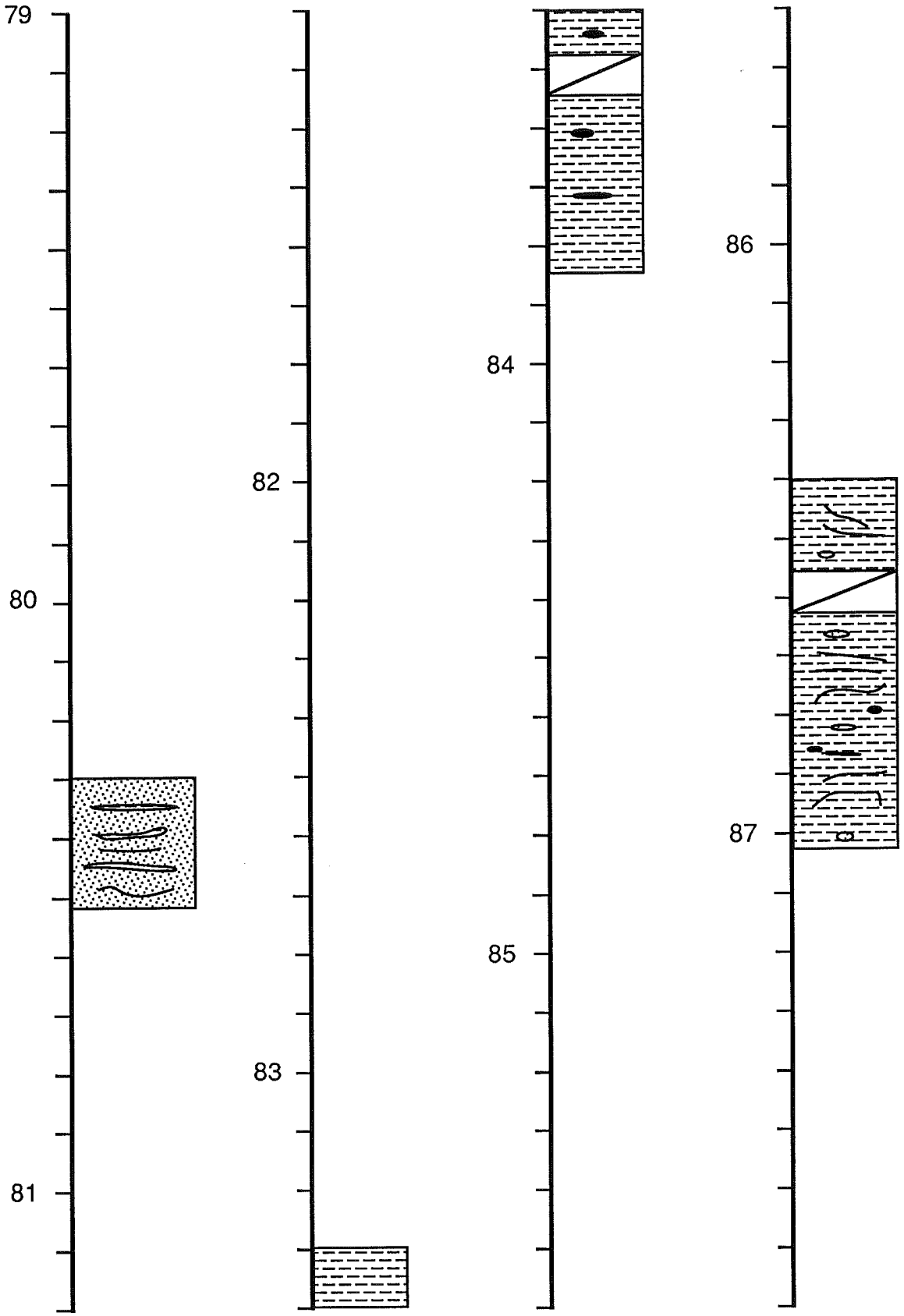
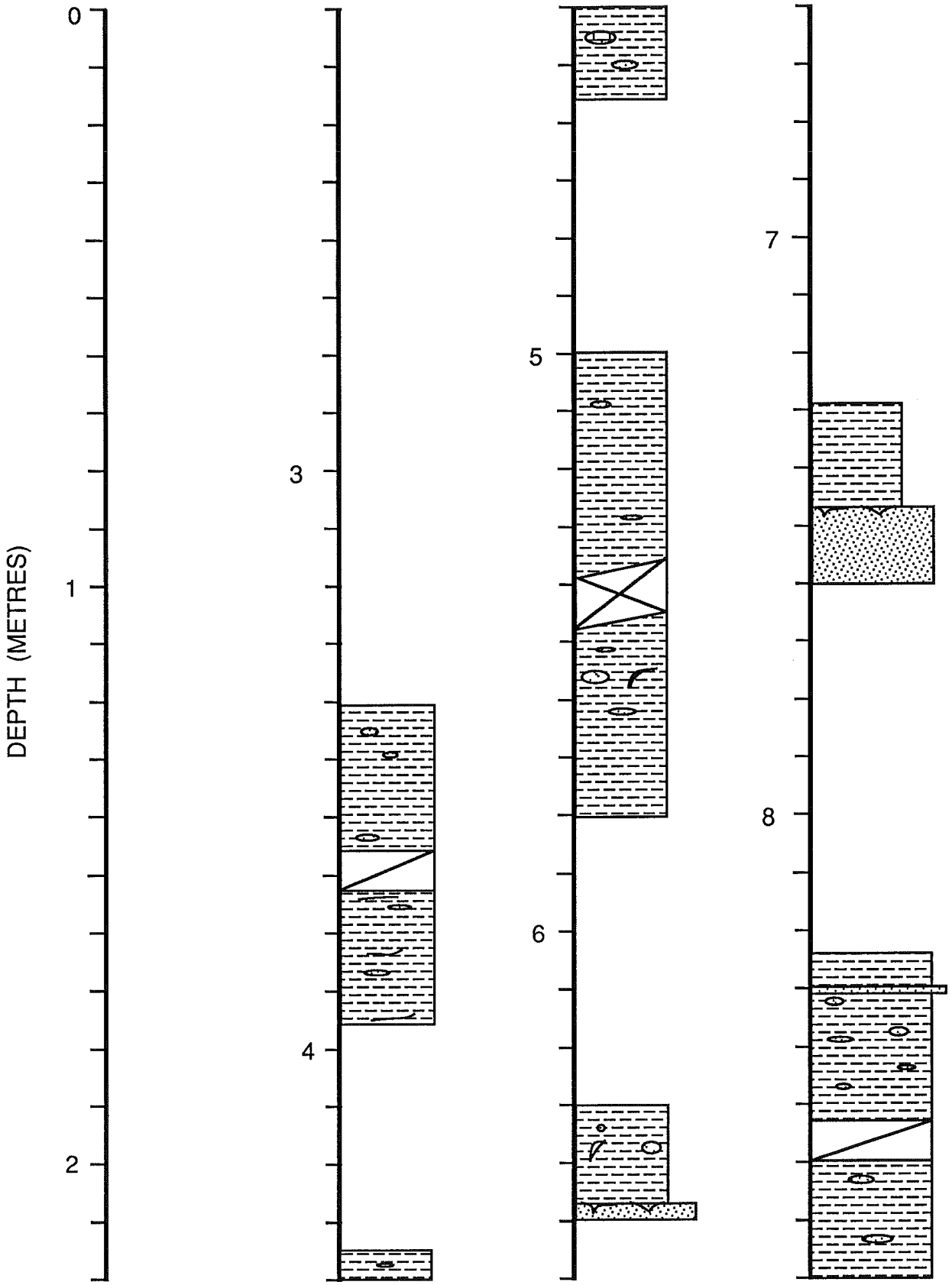
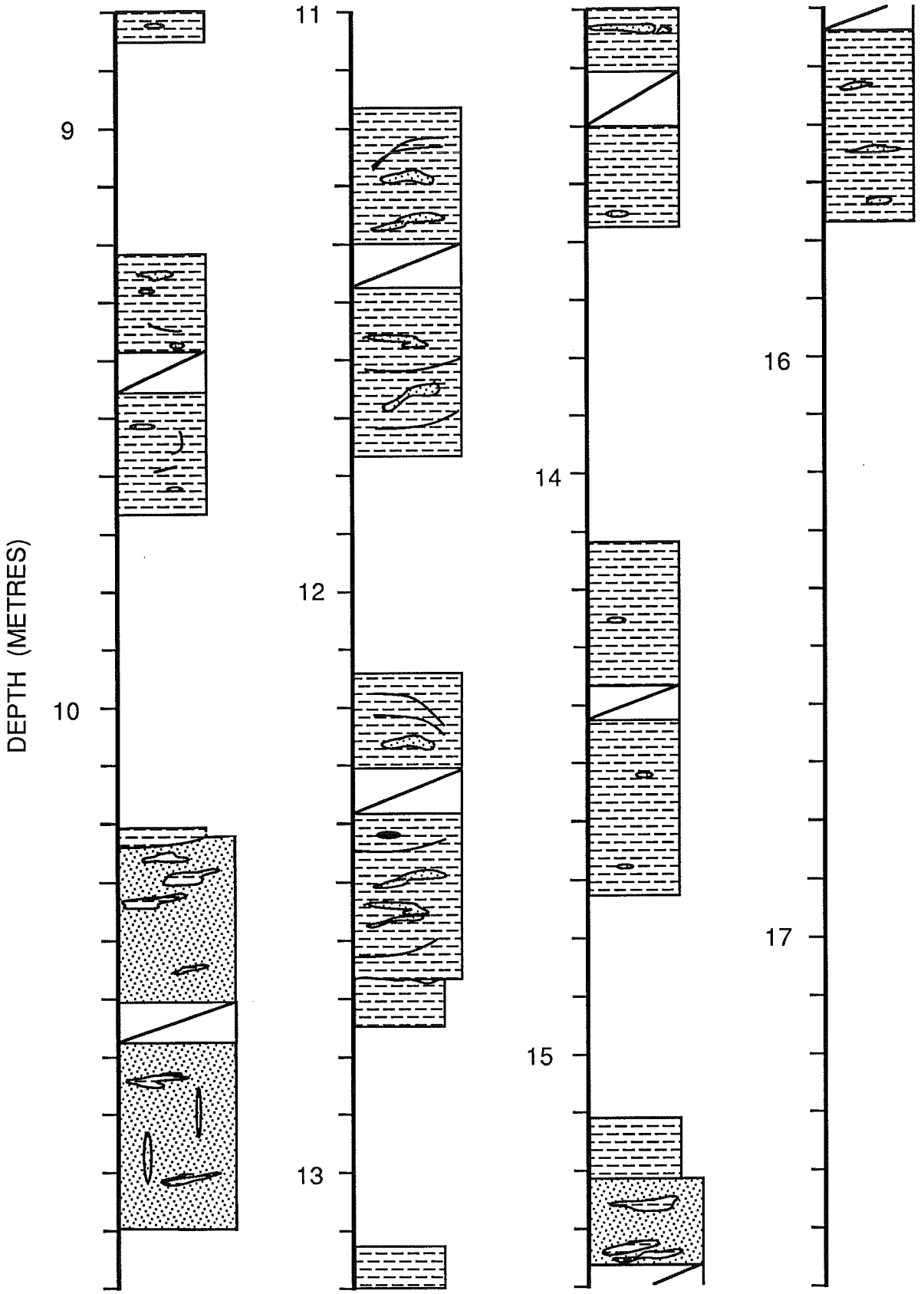


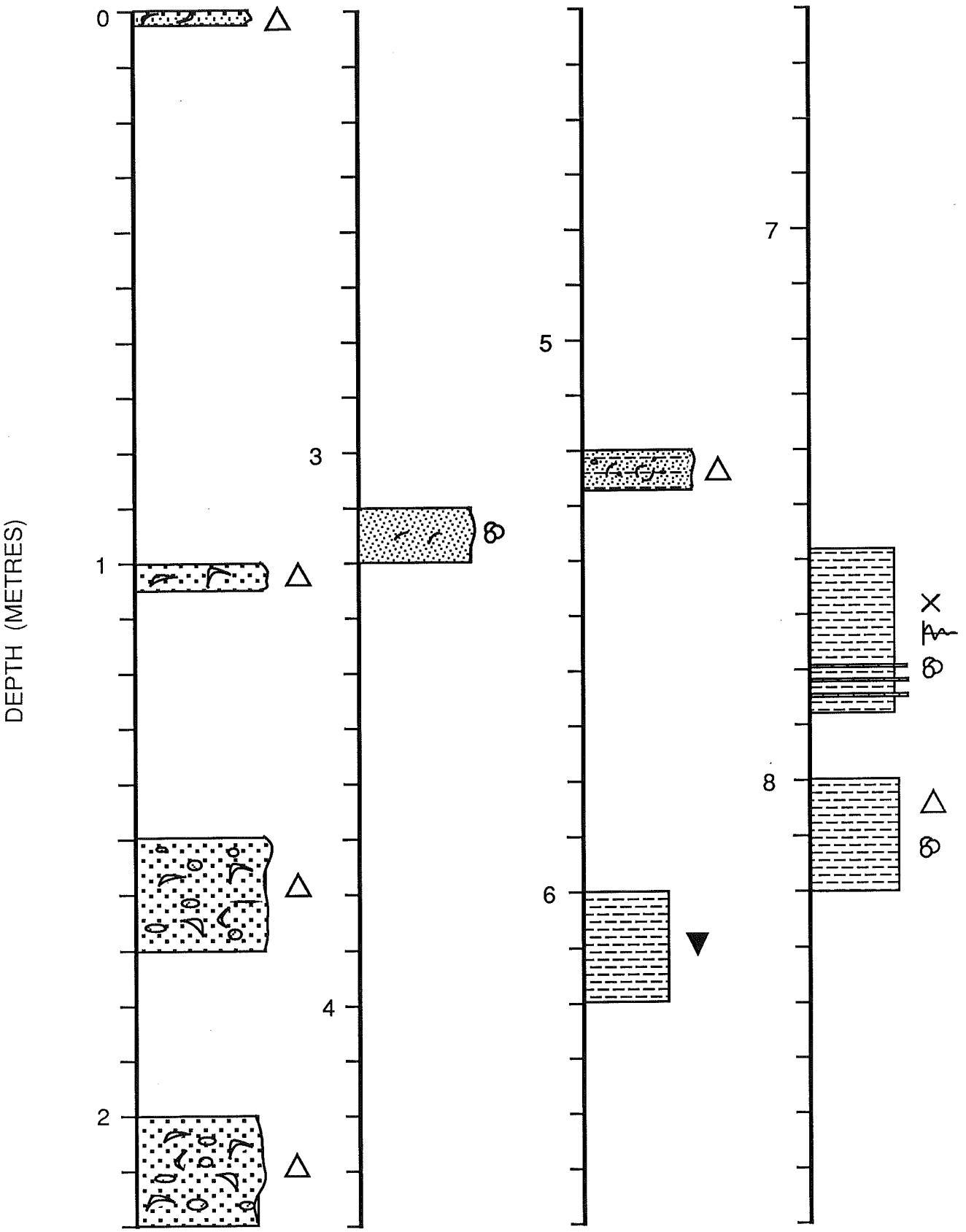
88400 - 07 (reference site)



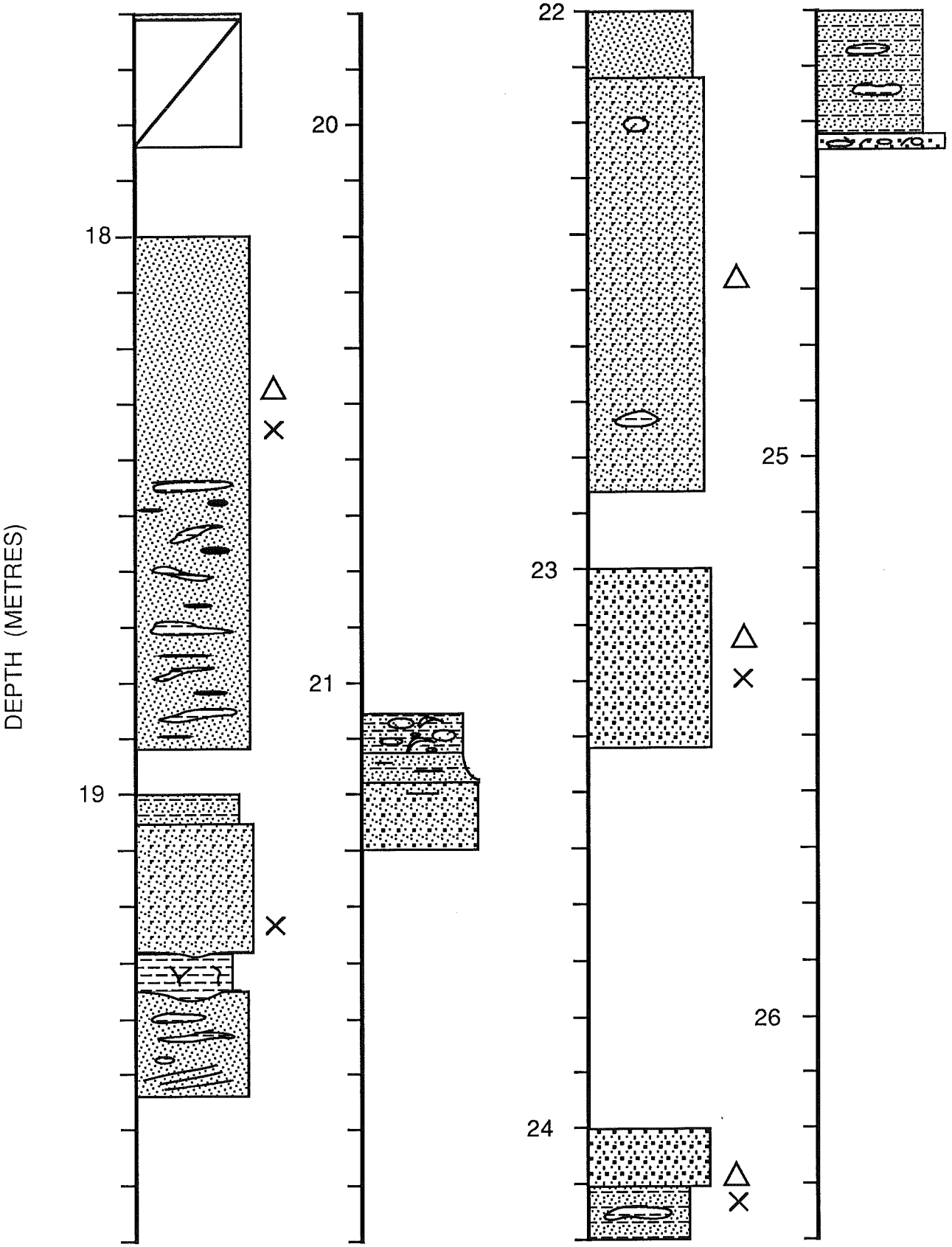
88400 - 07 (reference site)



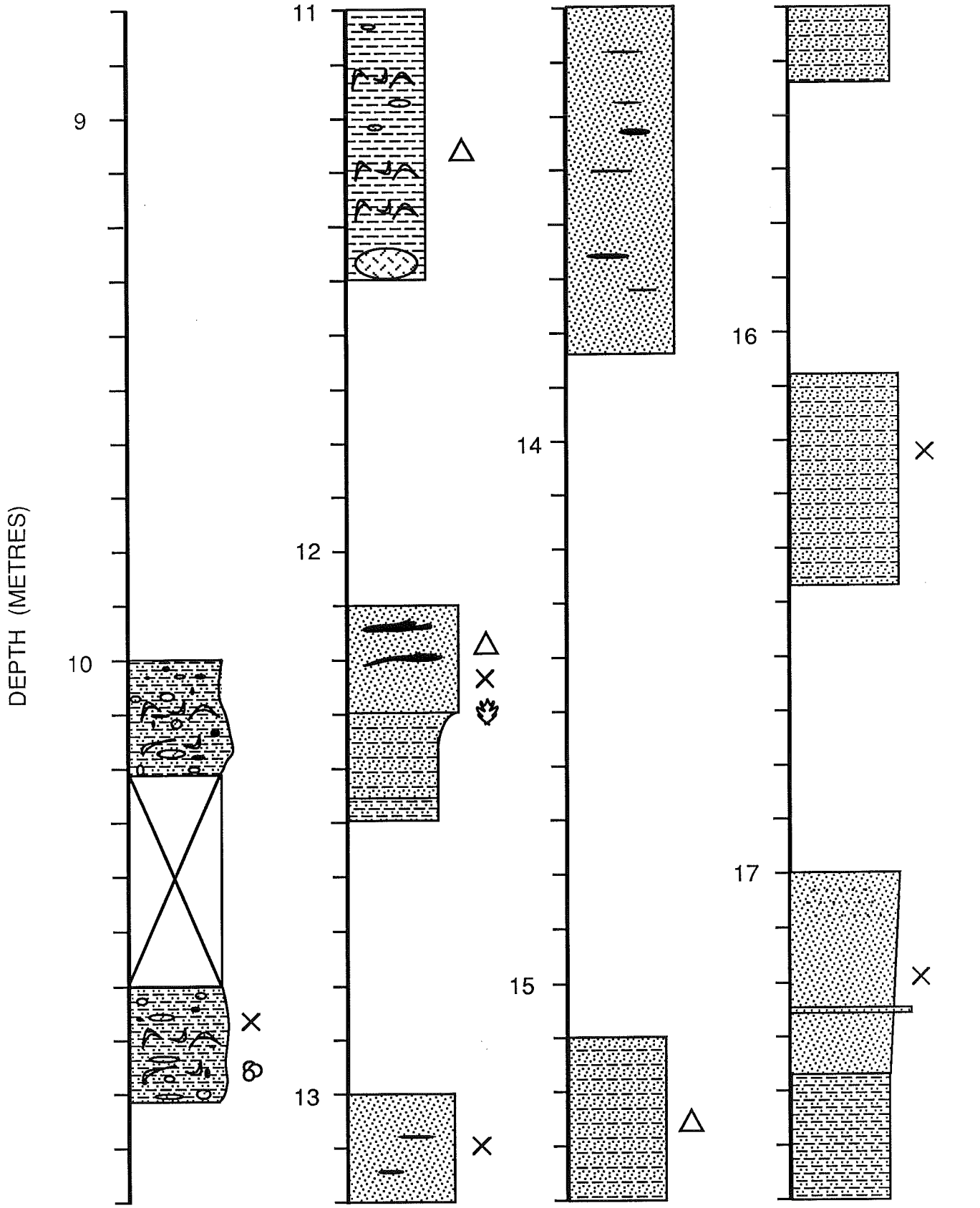
88401-G1 & G1A GBS Site



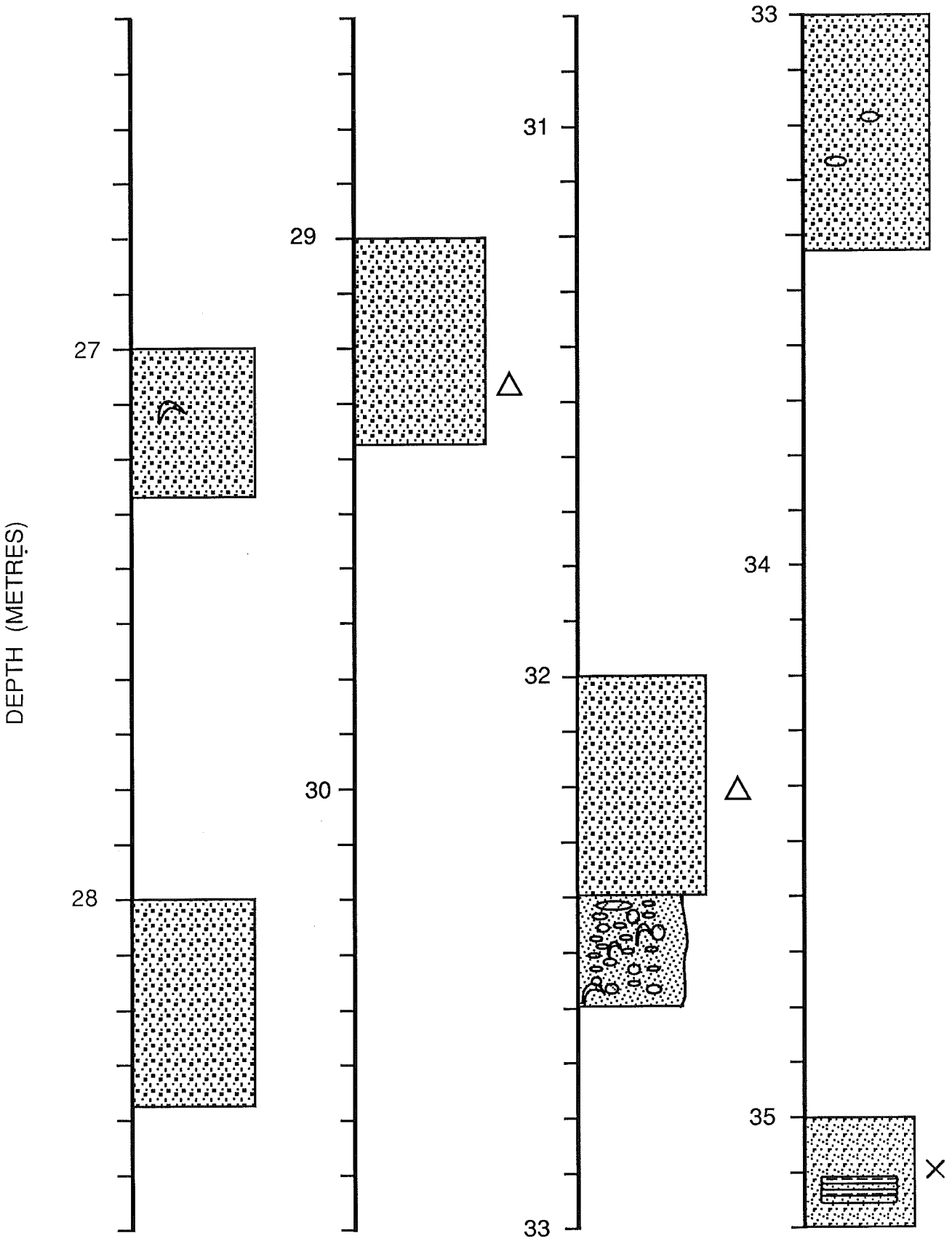
88401-G1 & G1A GBS Site



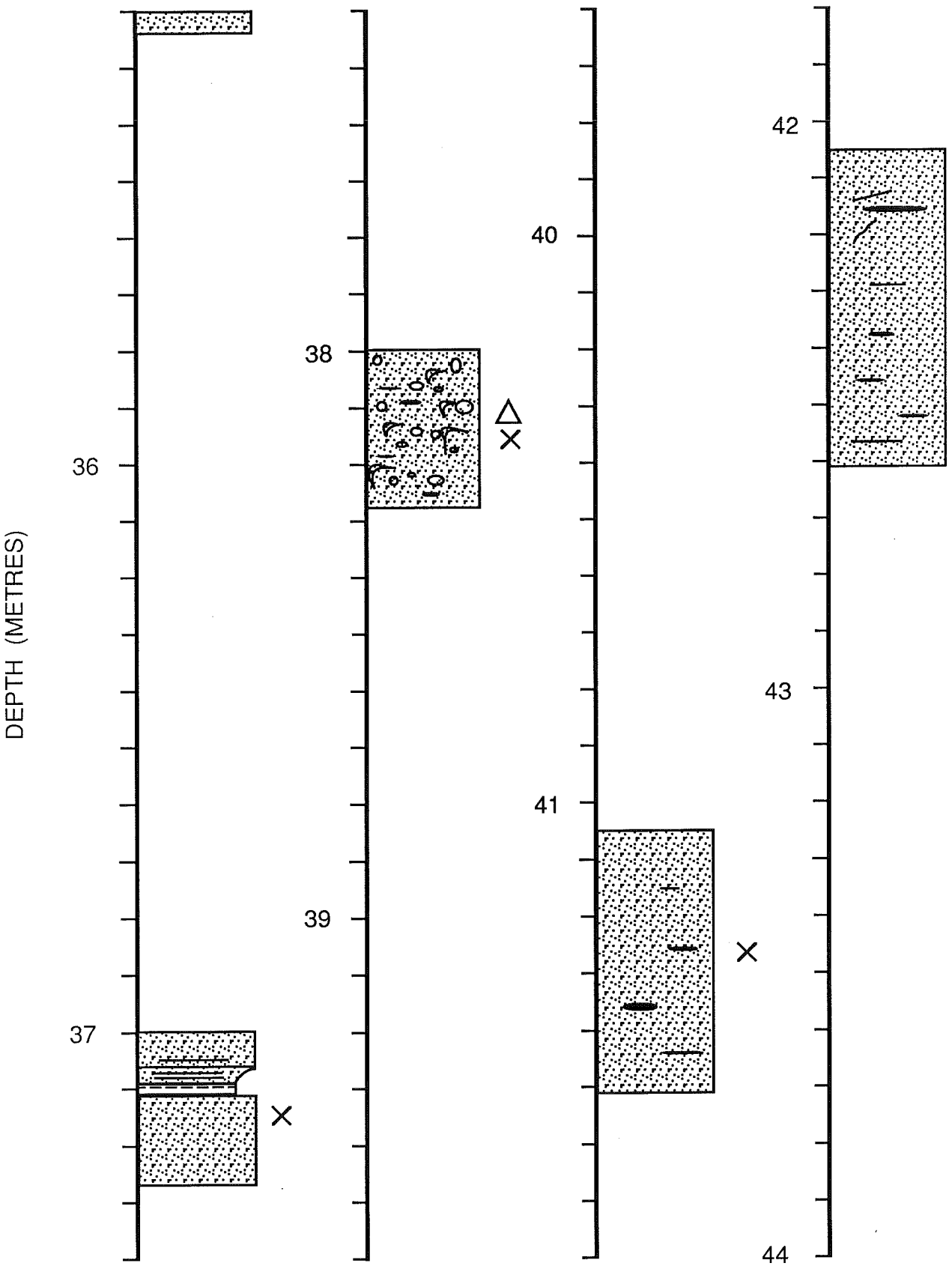
88401-G1 & G1A GBS Site



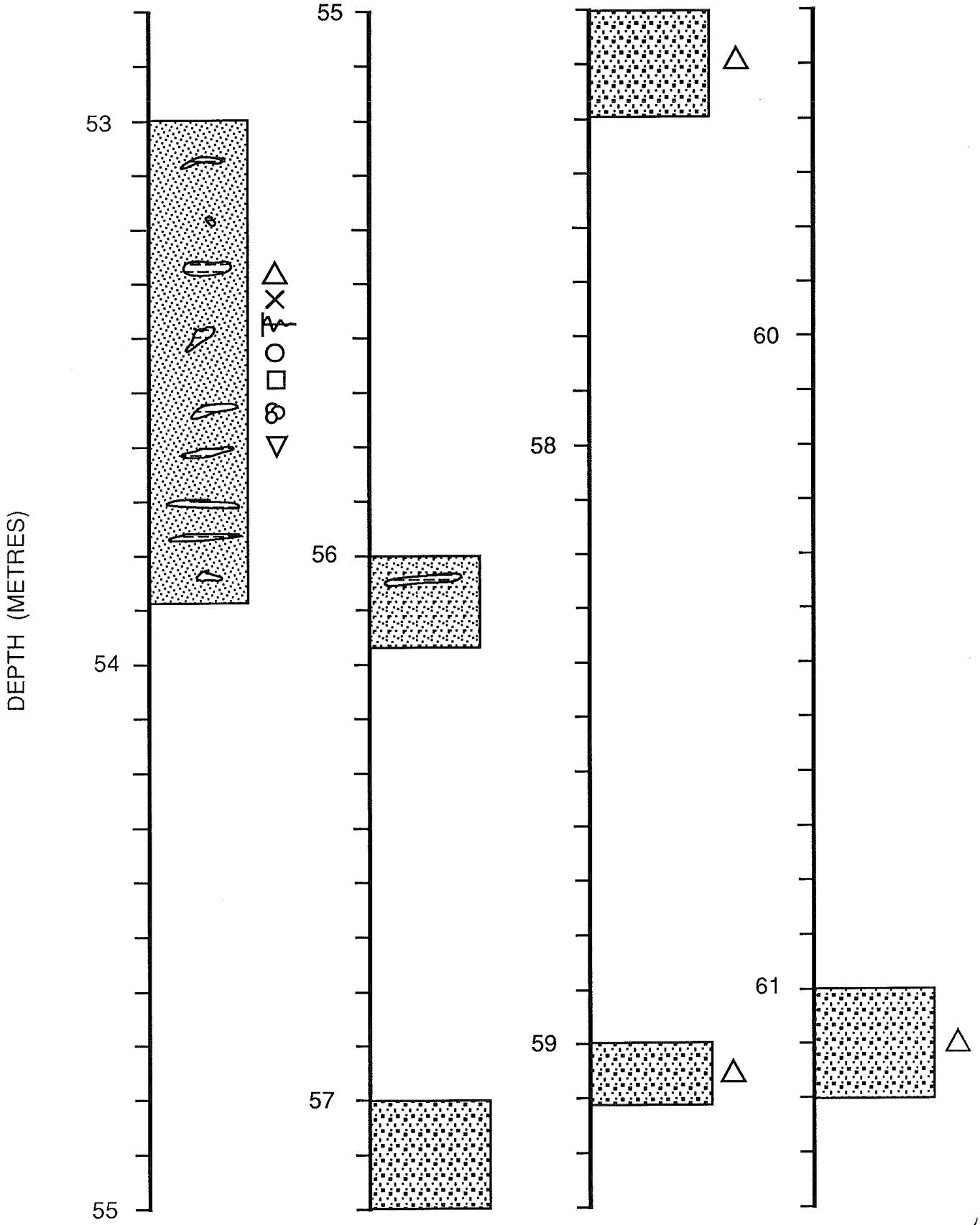
88401-G1 & G1A GBS Site



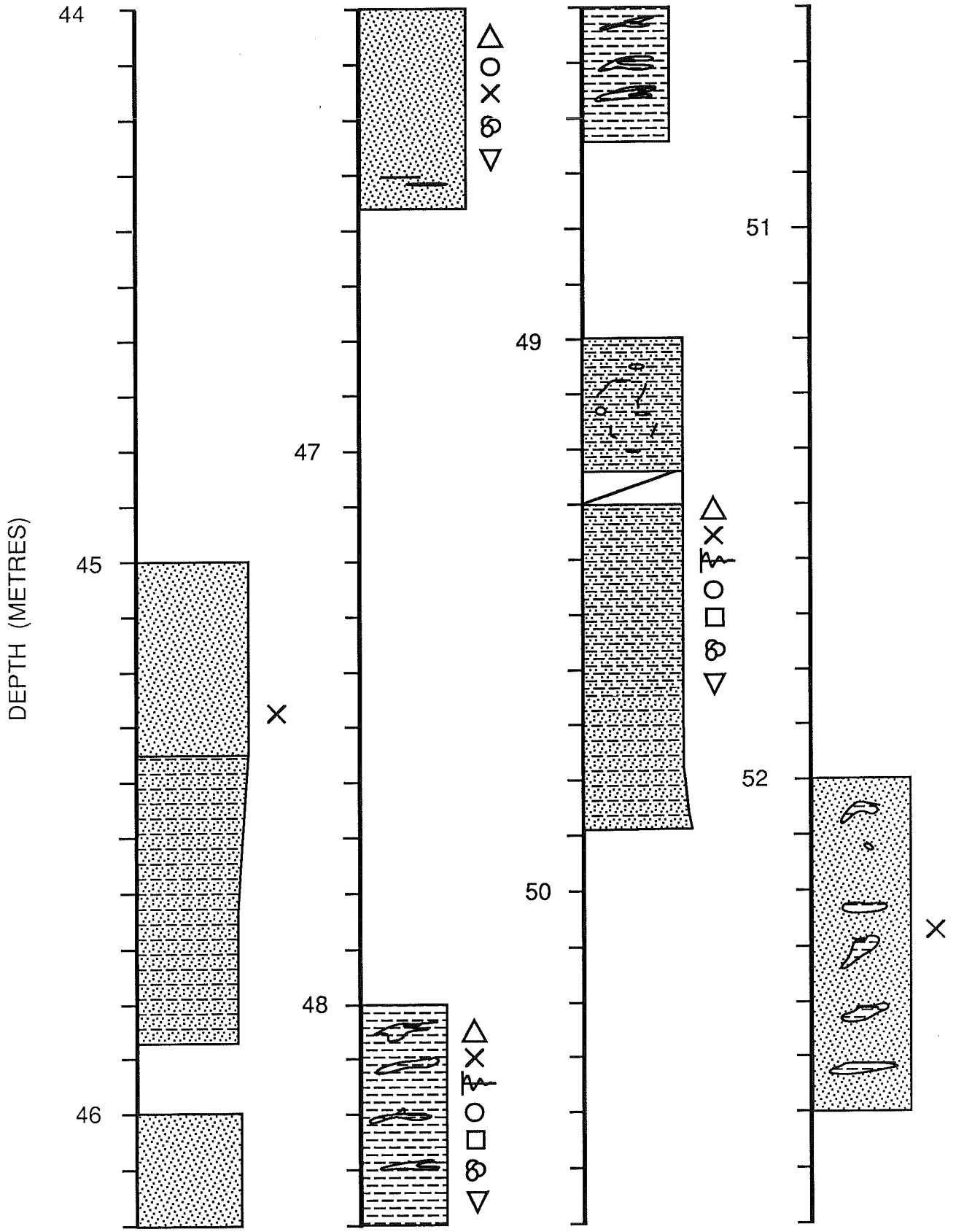
88401-G1 & G1A GBS Site



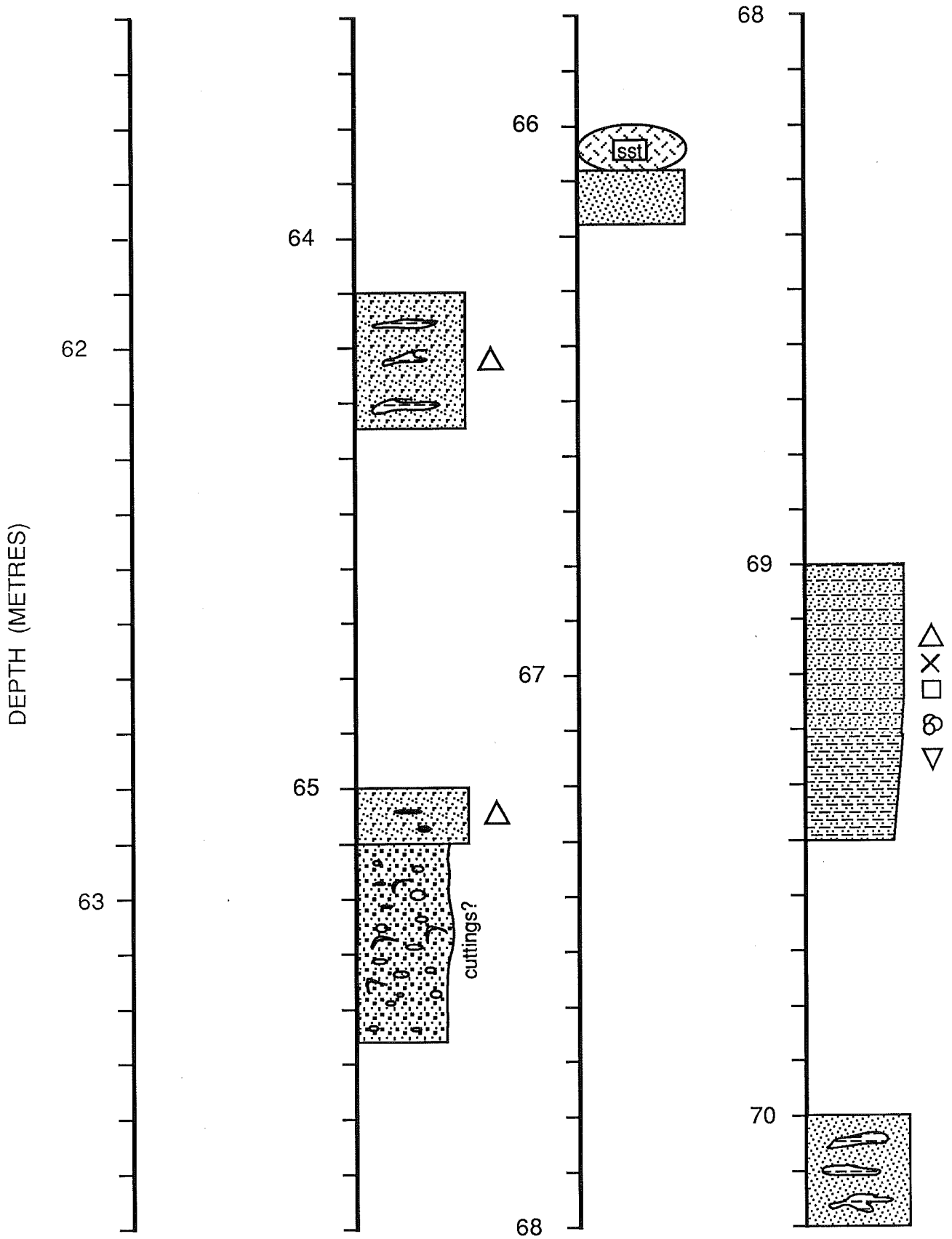
88401-G1 & G1A GBS Site



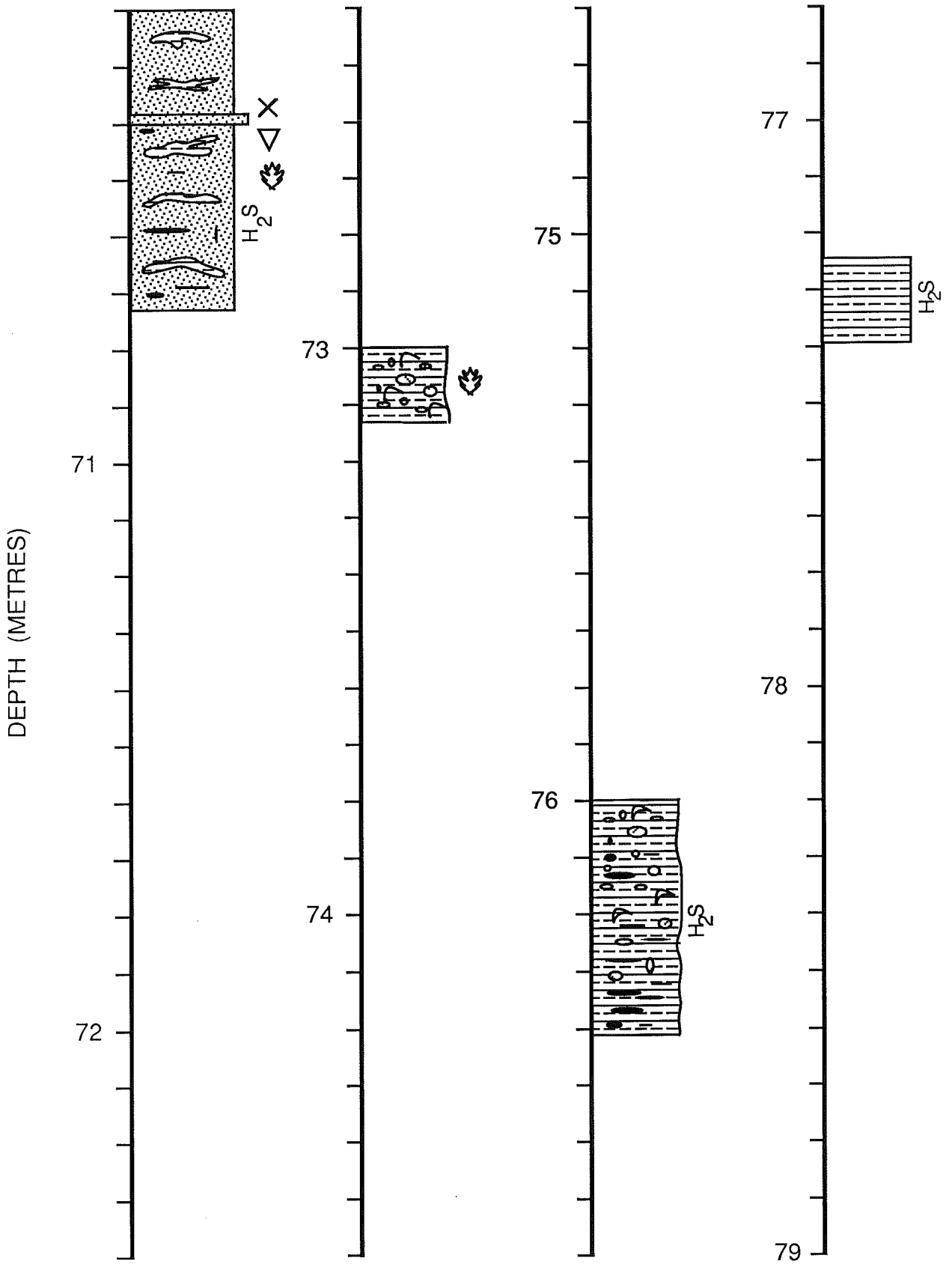
88401-G1 & G1A GBS Site



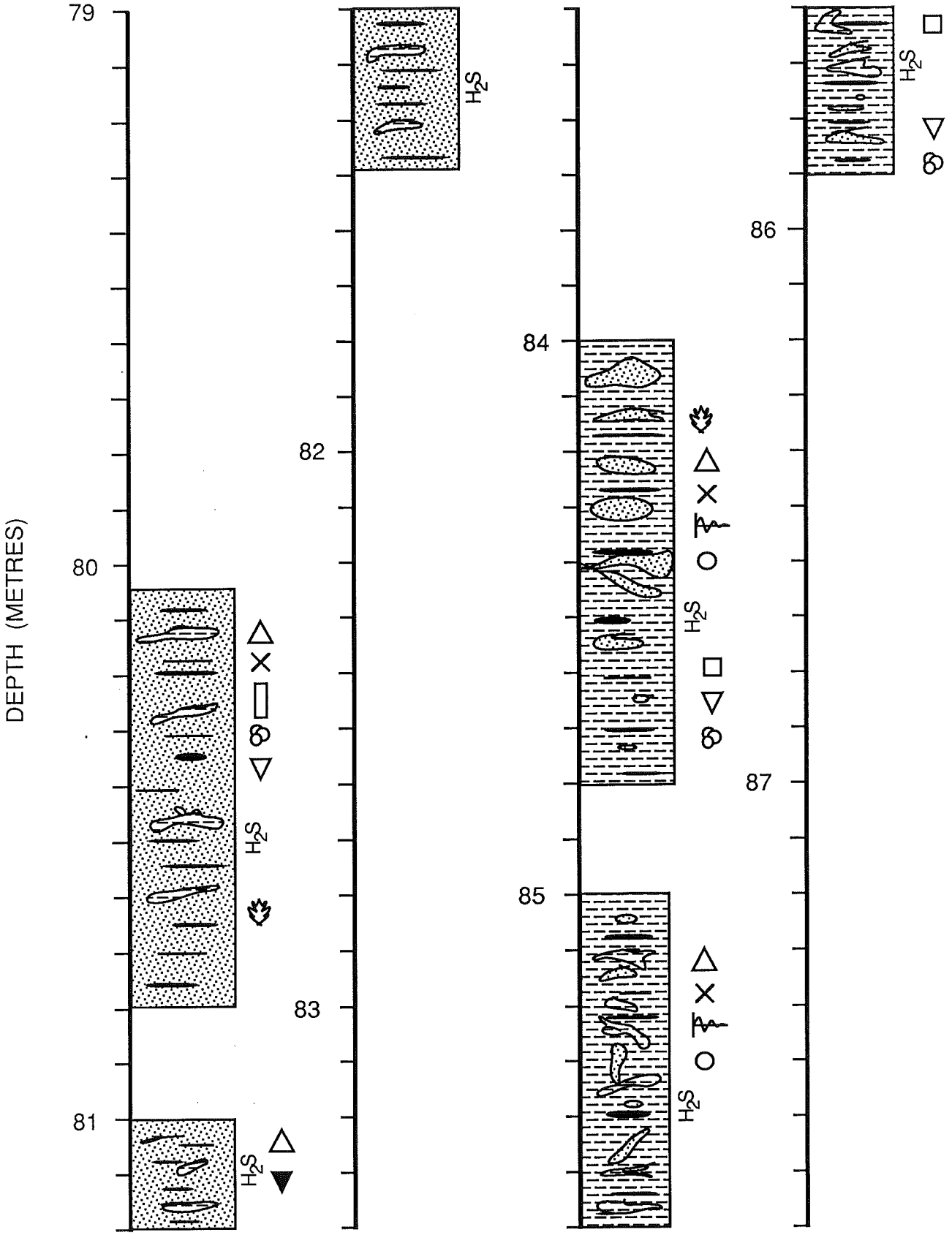
88401-G1 & G1A GBS Site



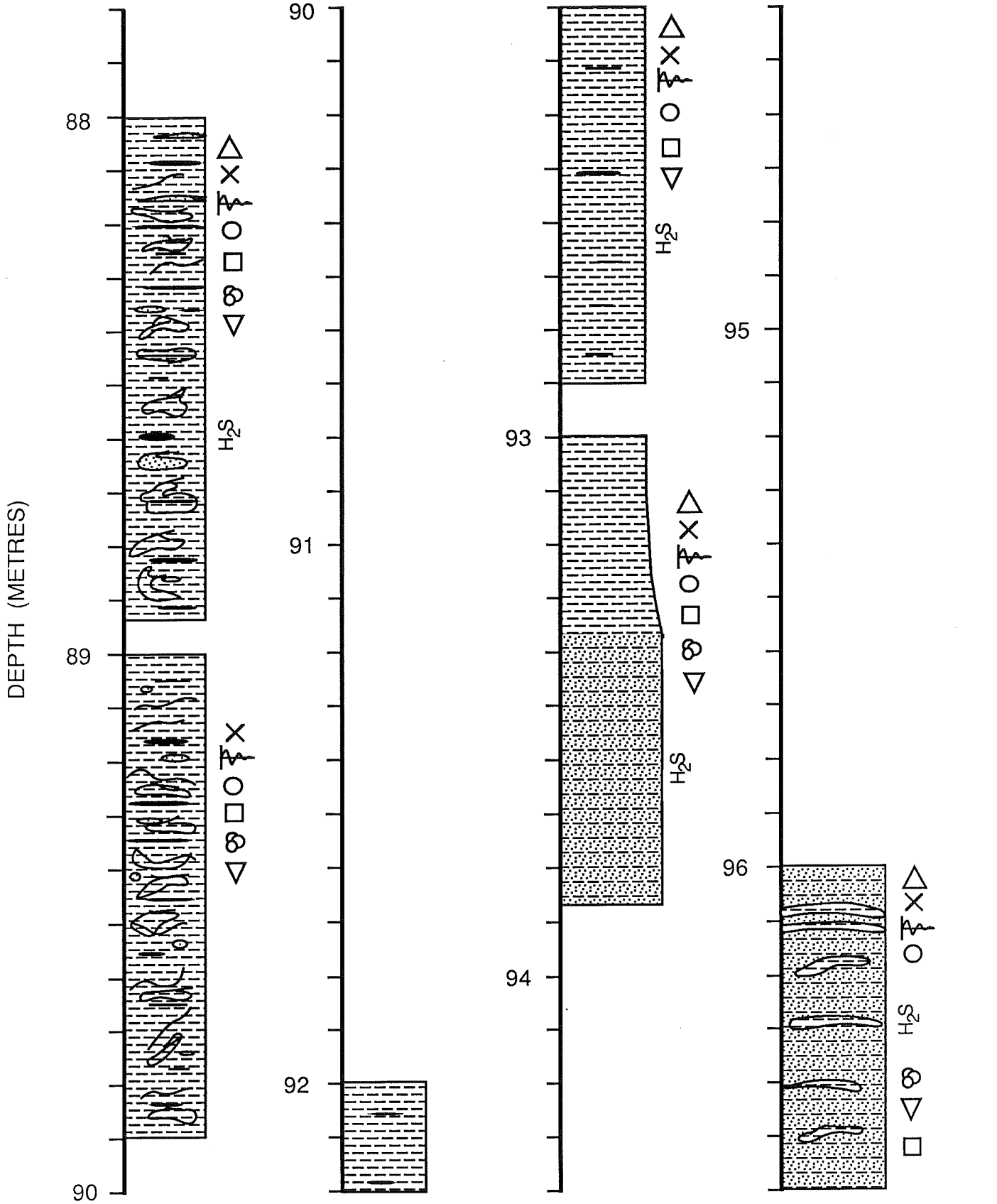
88401-G1 & G1A GBS Site



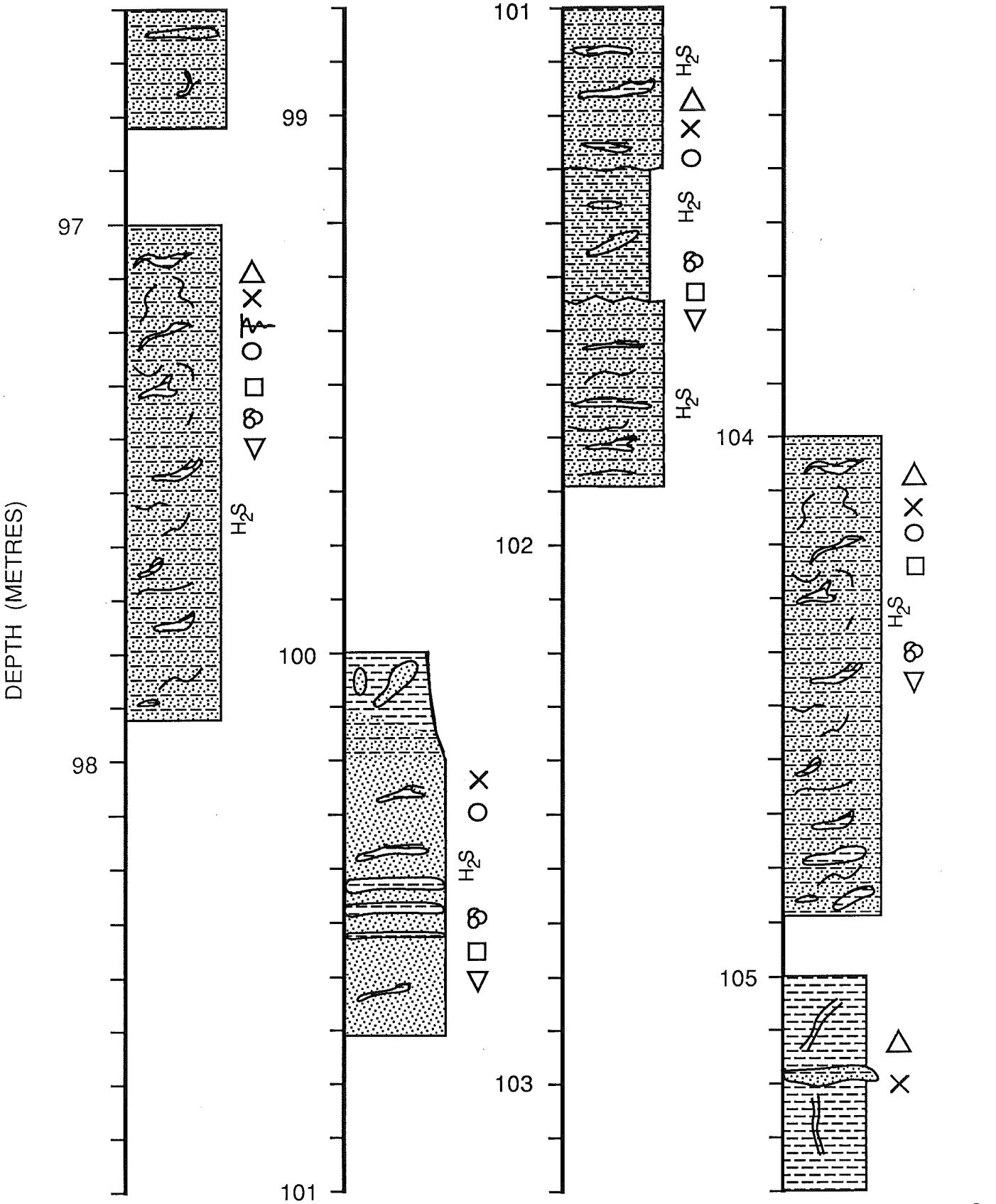
88401-G1 & G1A GBS Site



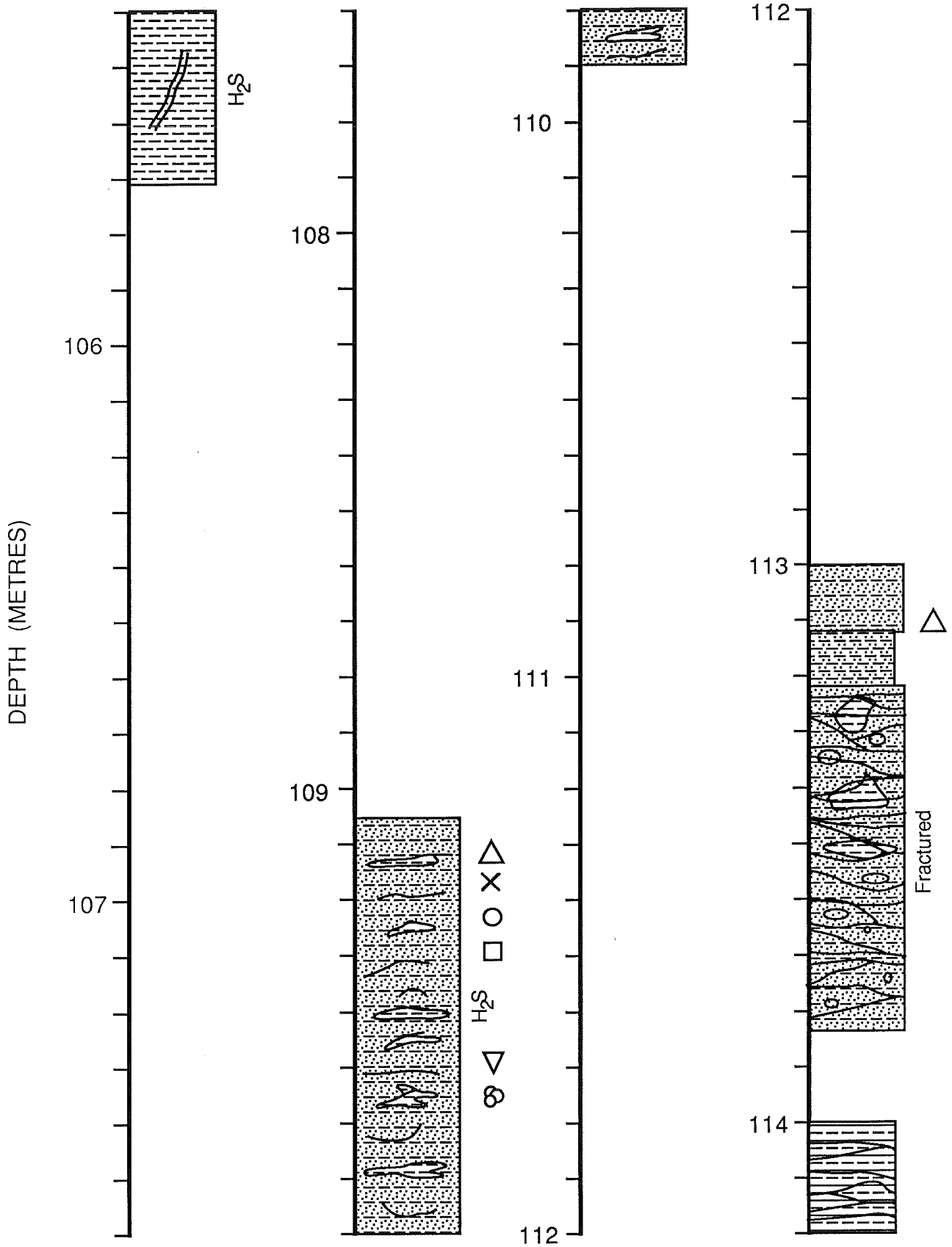
88401-G1 & G1A GBS Site



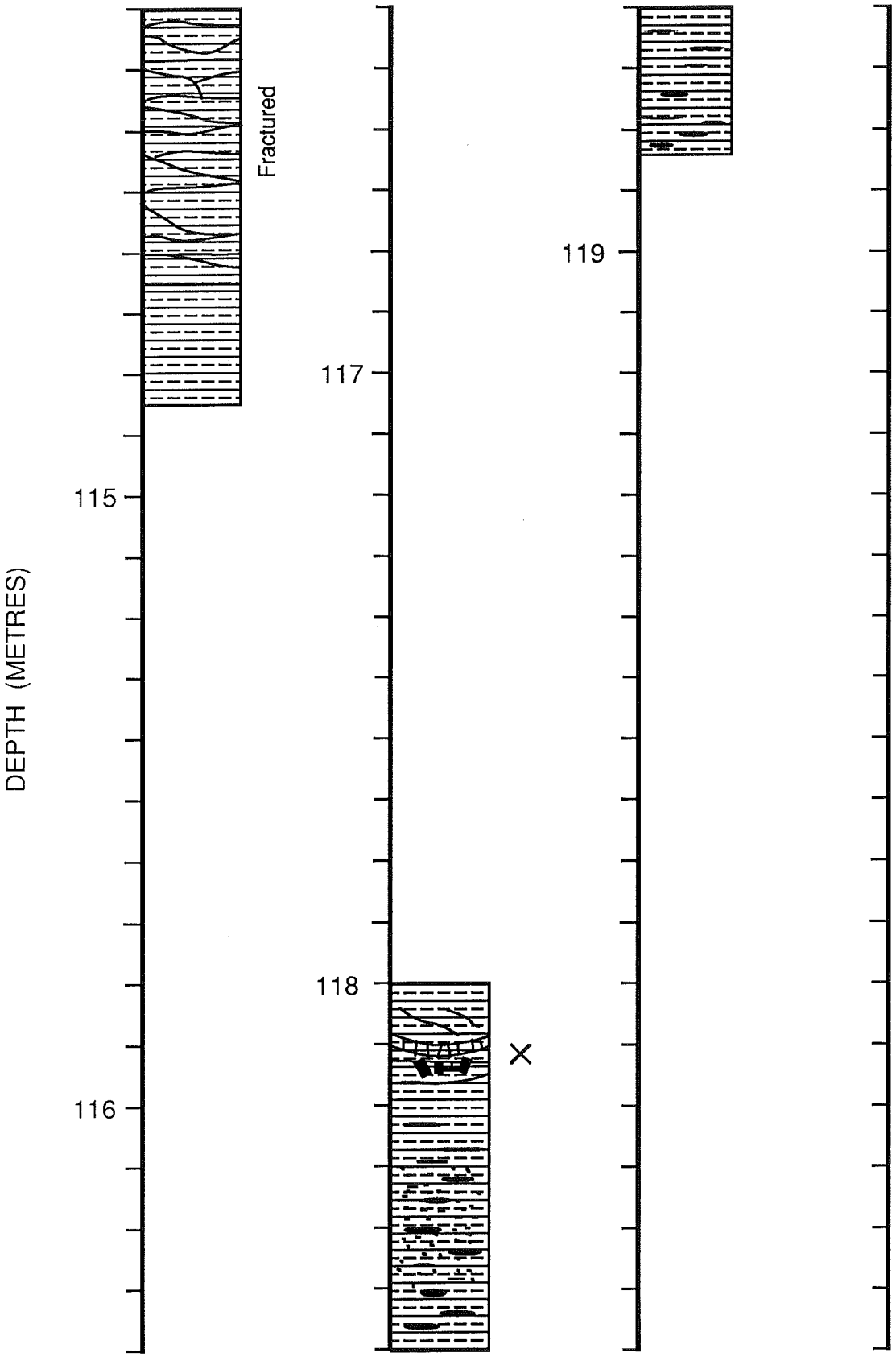
88401-G1 & G1A GBS Site



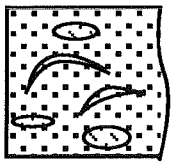
88401-G1 & G1A GBS Site



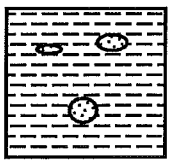
88401-G1 & G1A GBS Site



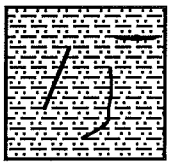
Legend



UNCONSOLIDATED SAND and GRAVEL, poorly sorted, abundant shell fragments

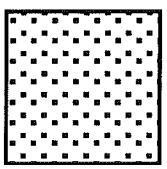


SILTY CLAY, massive, bioturbated - usually marbled or mottled with black organic streaks, burrows and traces. Burrow infilling with silty sand is common.



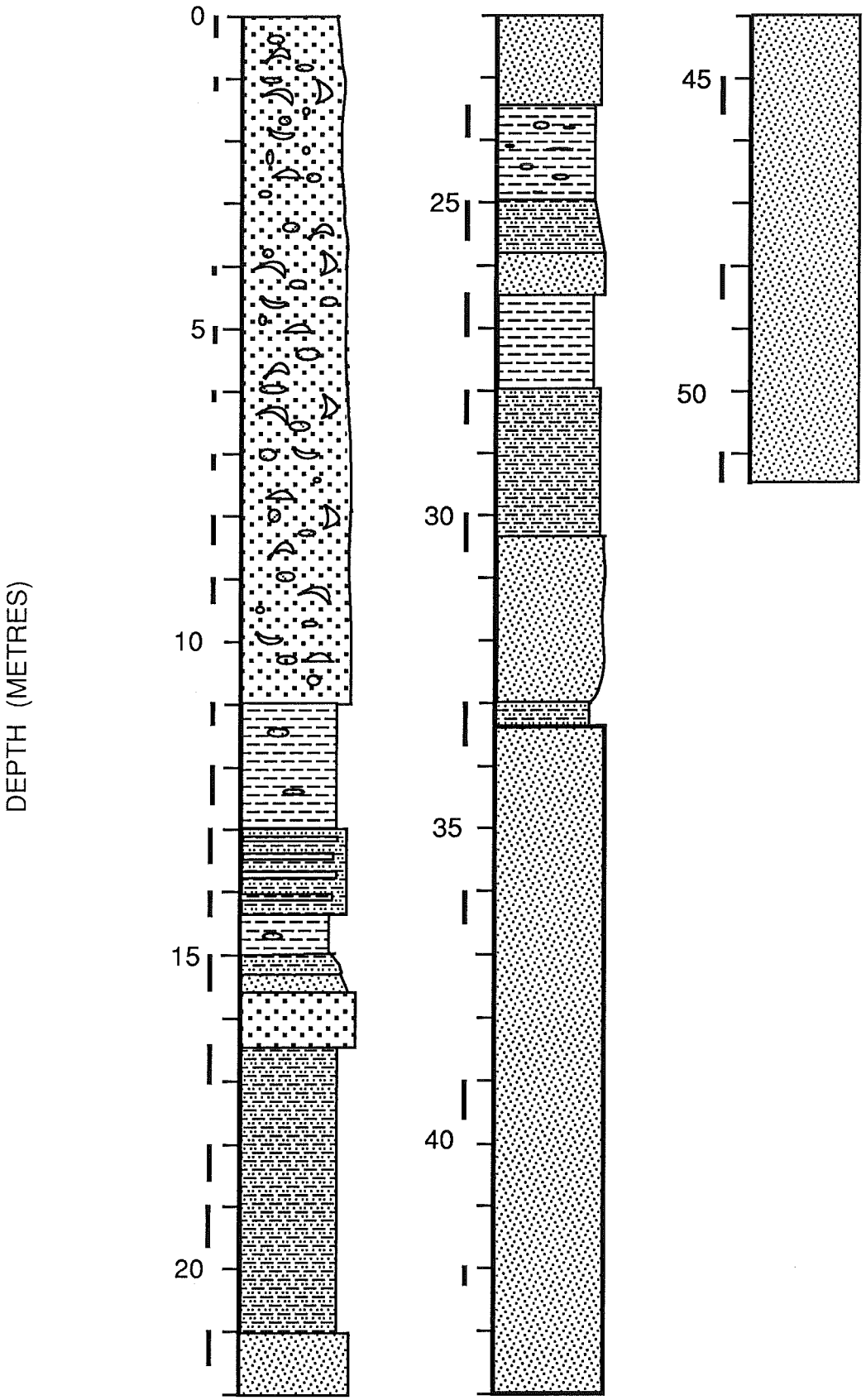
SILT to SANDY SILT, typically structureless, and high in organics, burrows and traces common.

SILTY SAND to FINE SAND, structureless or with wispy laminae in X-ray, usually bioturbated, evident with silty-clay mottles and marbling.

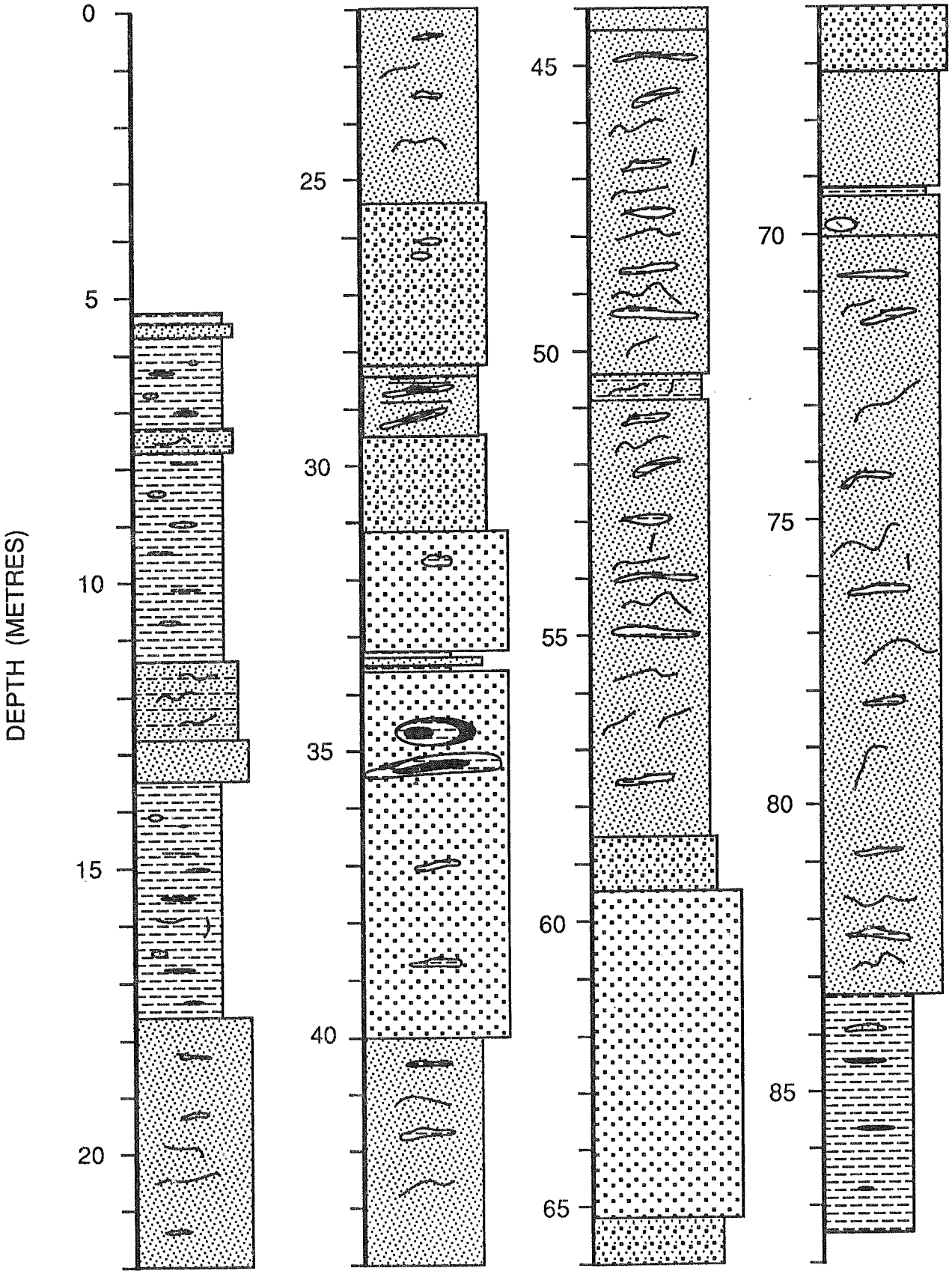


MEDIUM TO COARSE SAND, strucutureless, though occassionally occurring in thin (cm) beds, poorly sorted. Rarely bioturbated, evident by silty-clay mottles and marbling. Contacts with adjacent facies (usually fine sand) are sharp,and either regular or irregular.

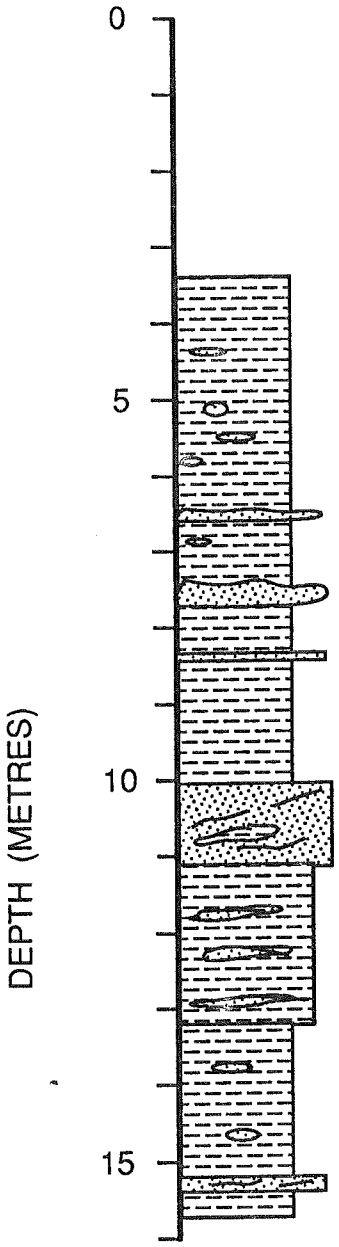
88400-01 Terra Nova



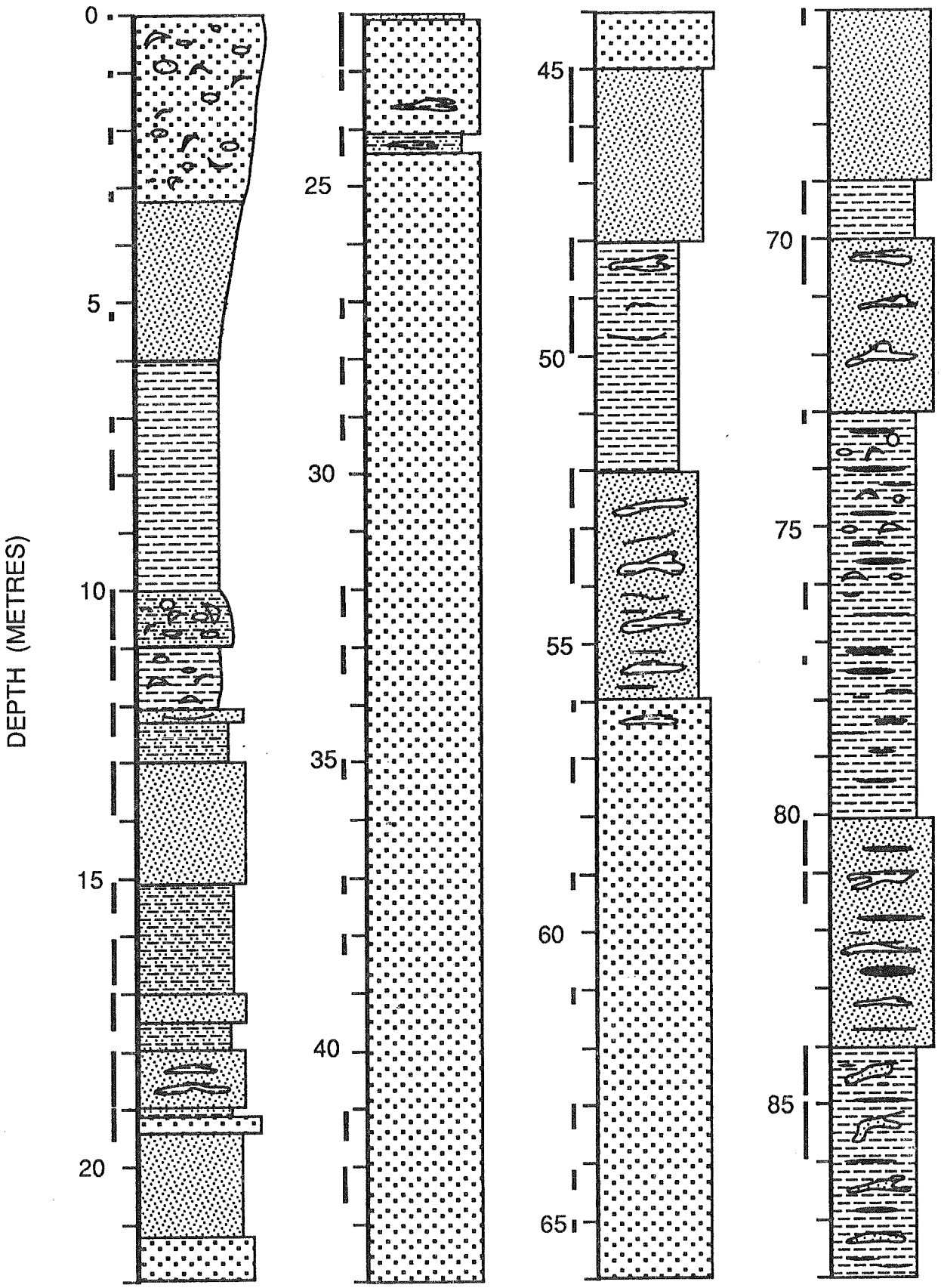
88400-06 Bowers Pit



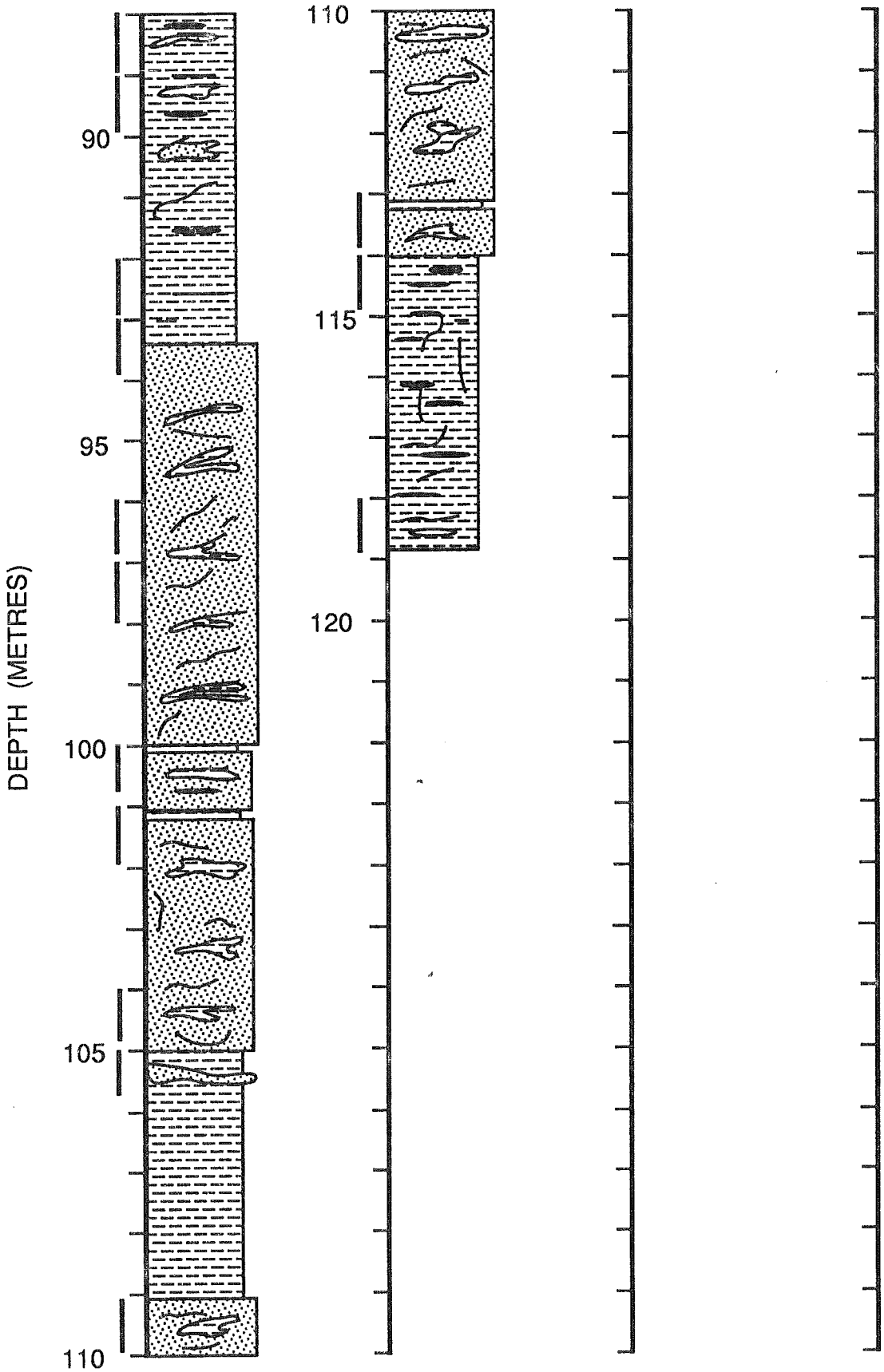
88400-07 reference site

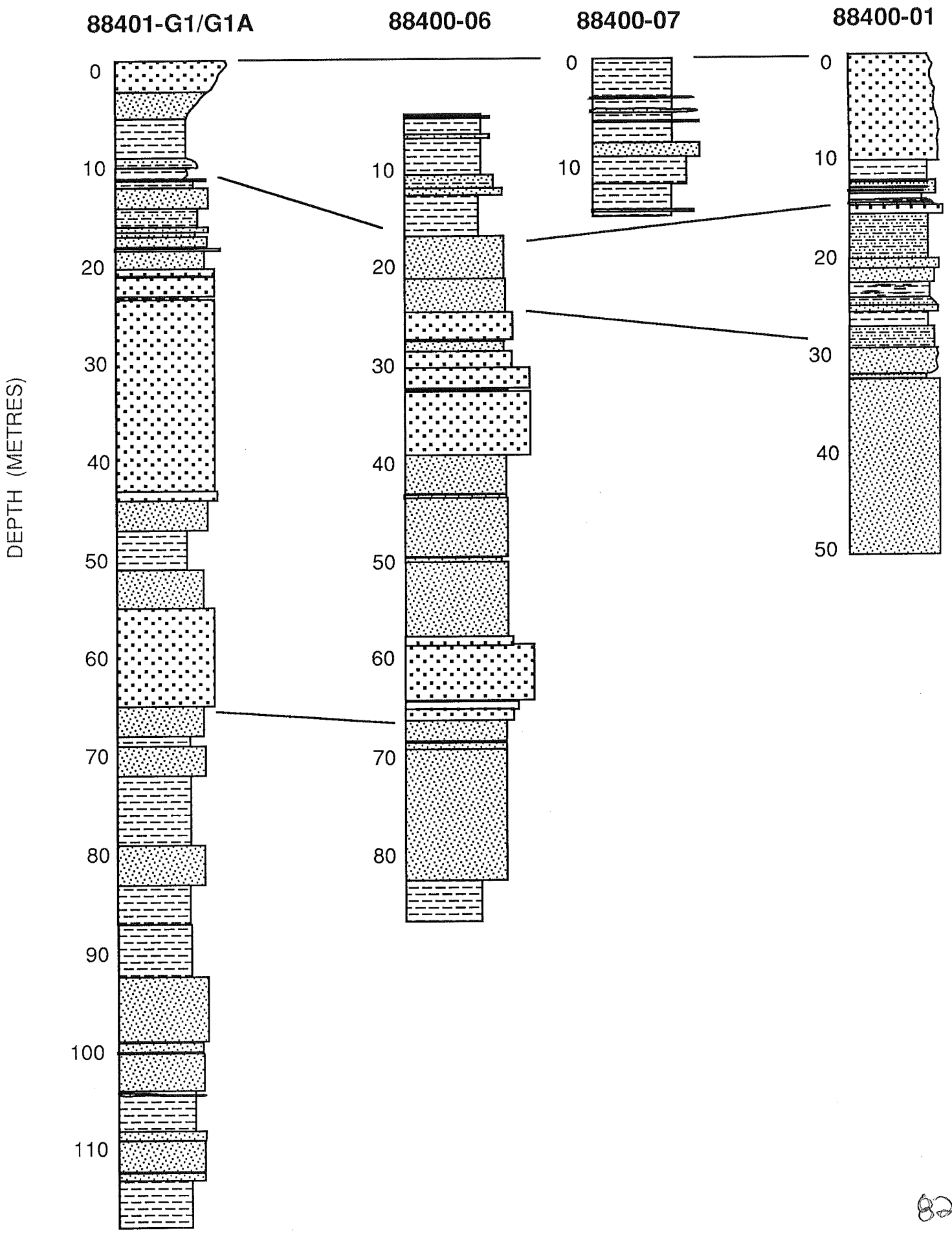


88401-G1 & G1A GBS Site

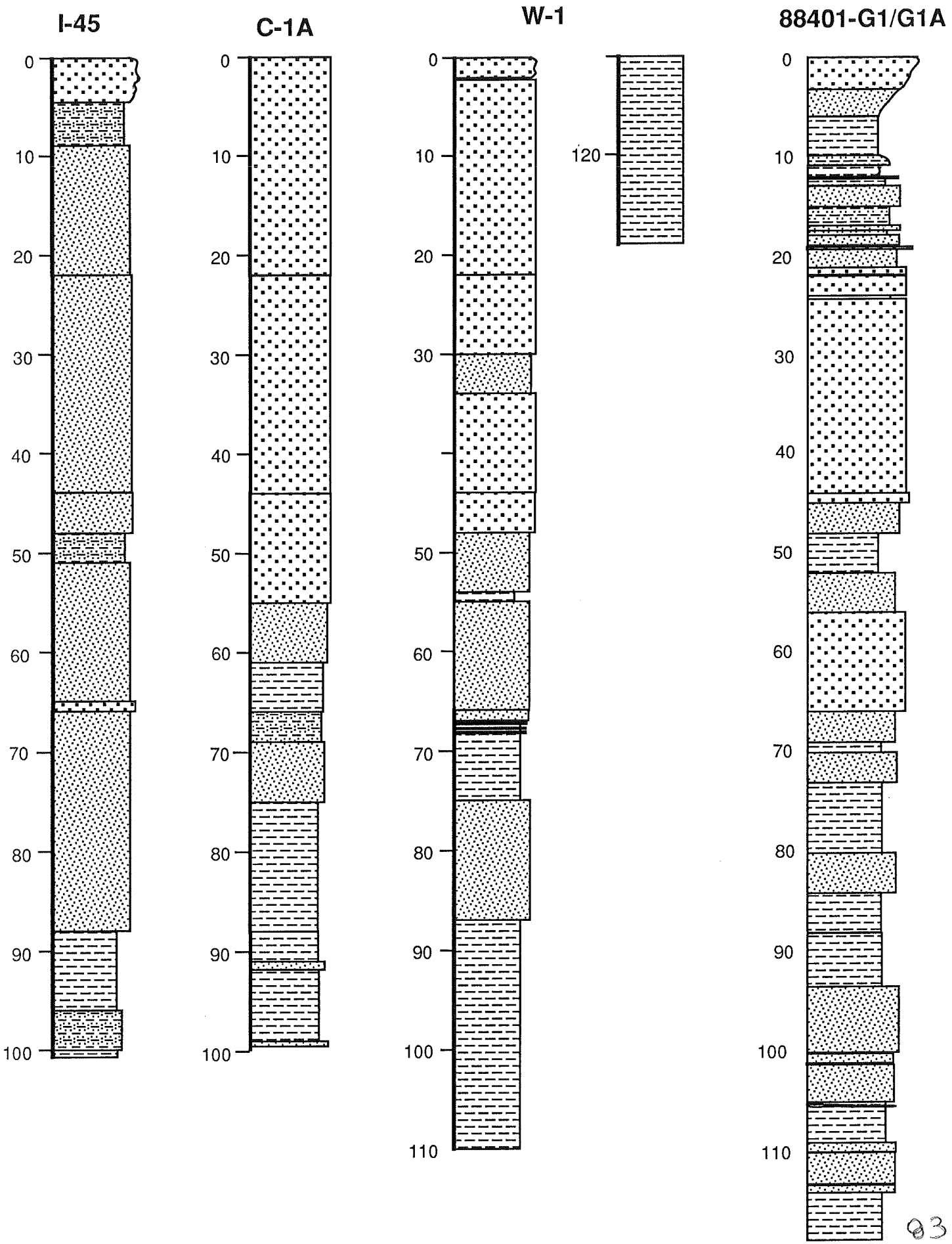


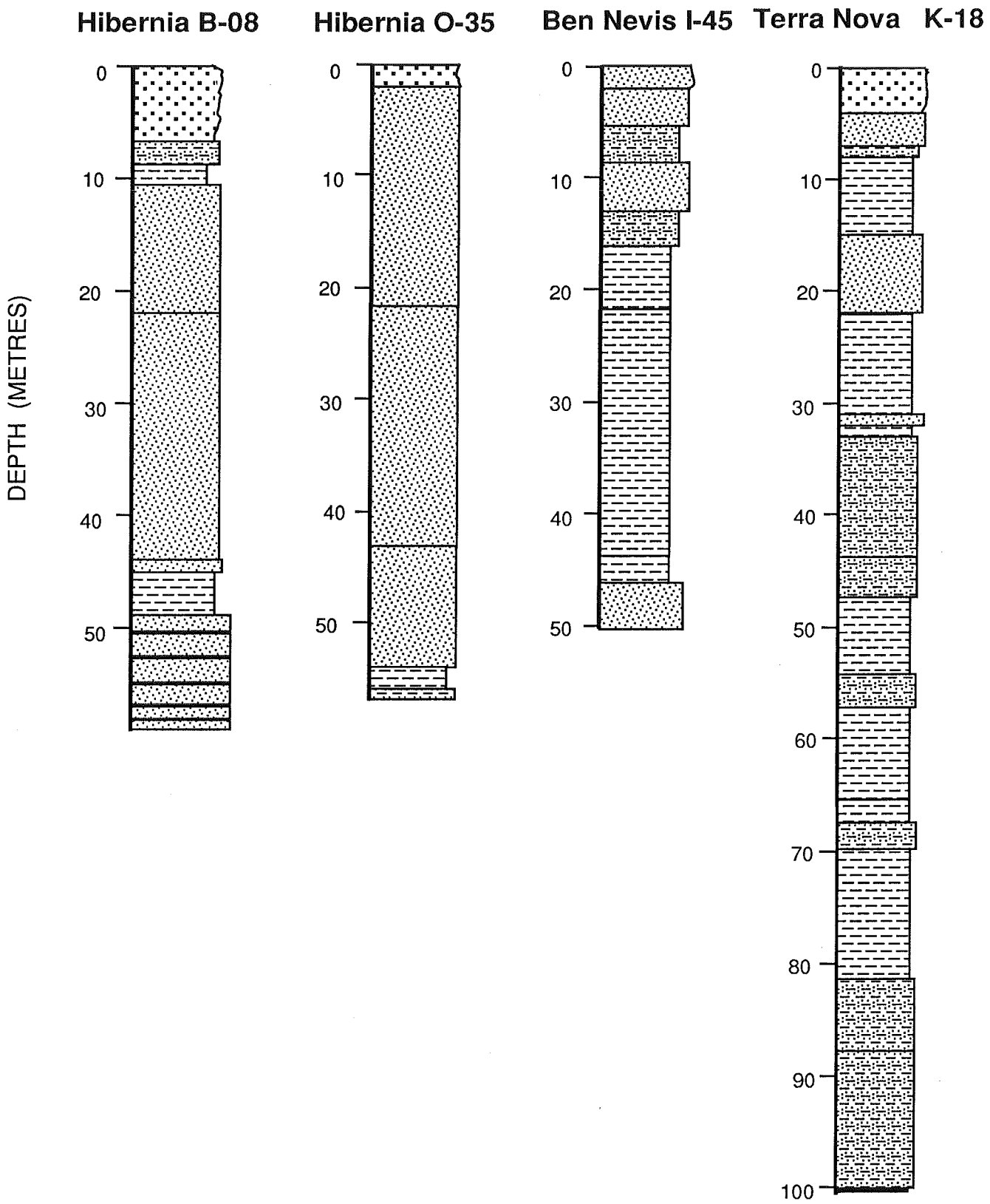
88401-G1 & G1A GBS Site



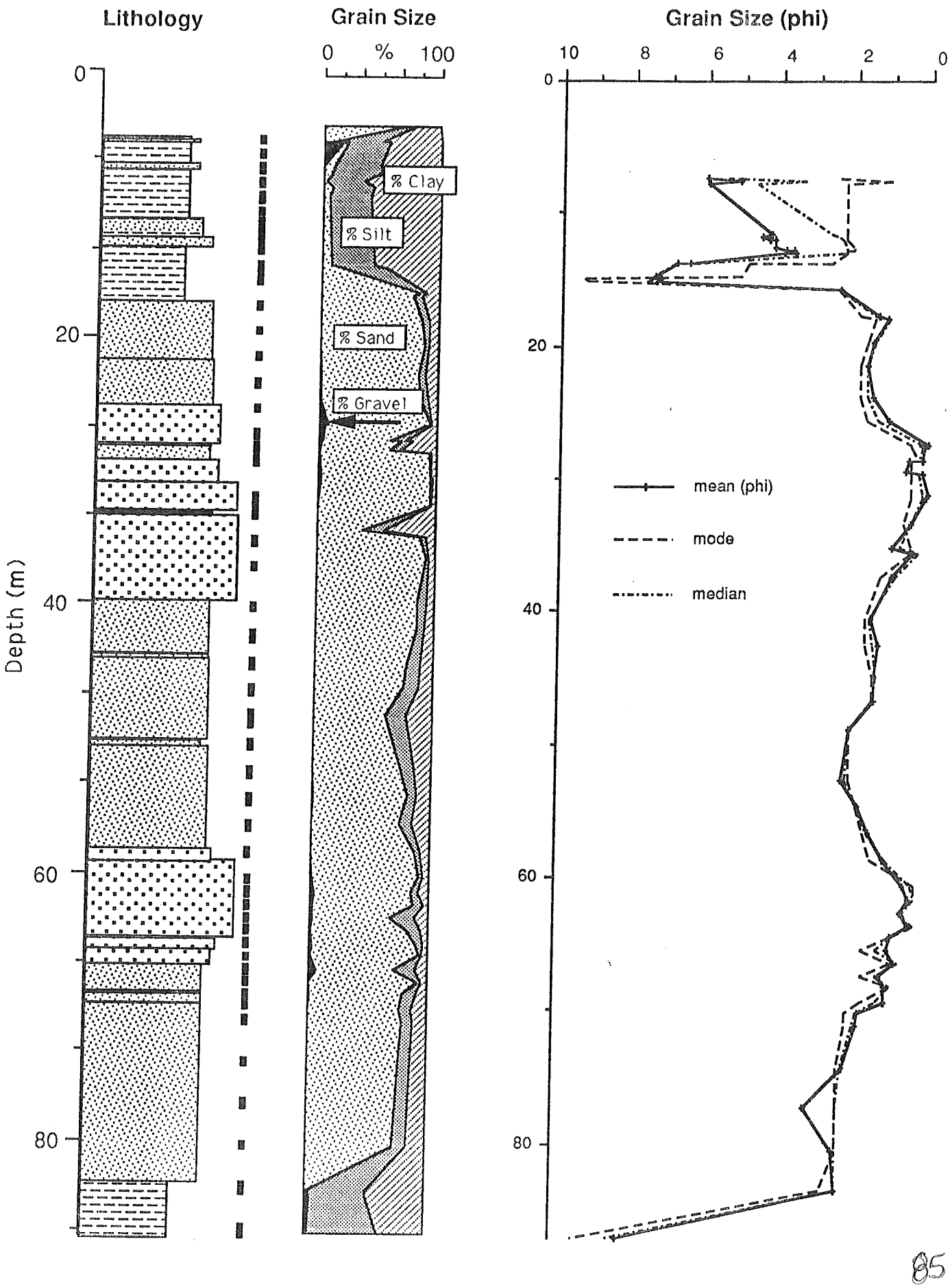

88401-G1/G1A
88400-06
88400-07
88400-01
DEPTH (METRES)
0
10
20
30
40
50
60
70
80
90
100
110

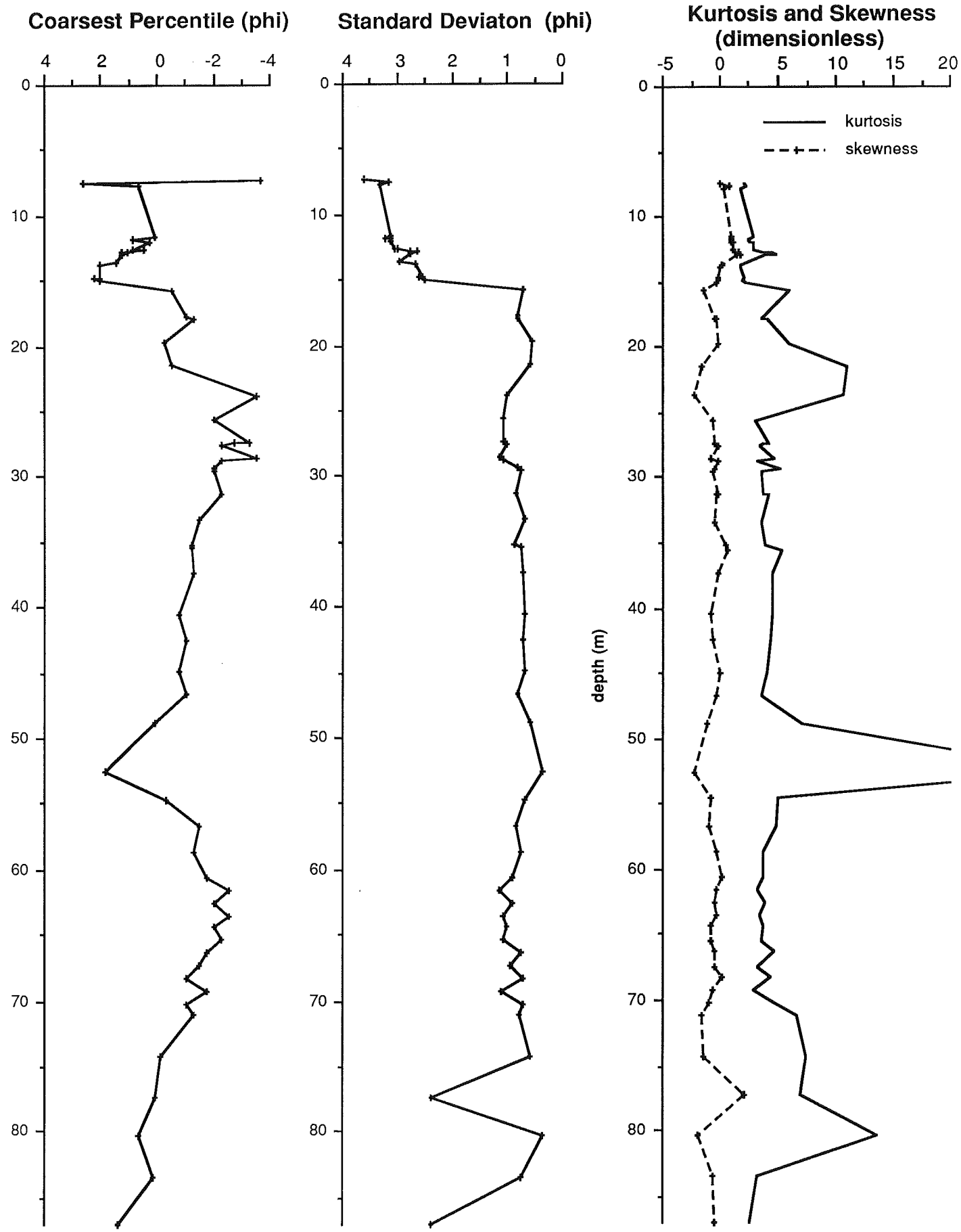
82

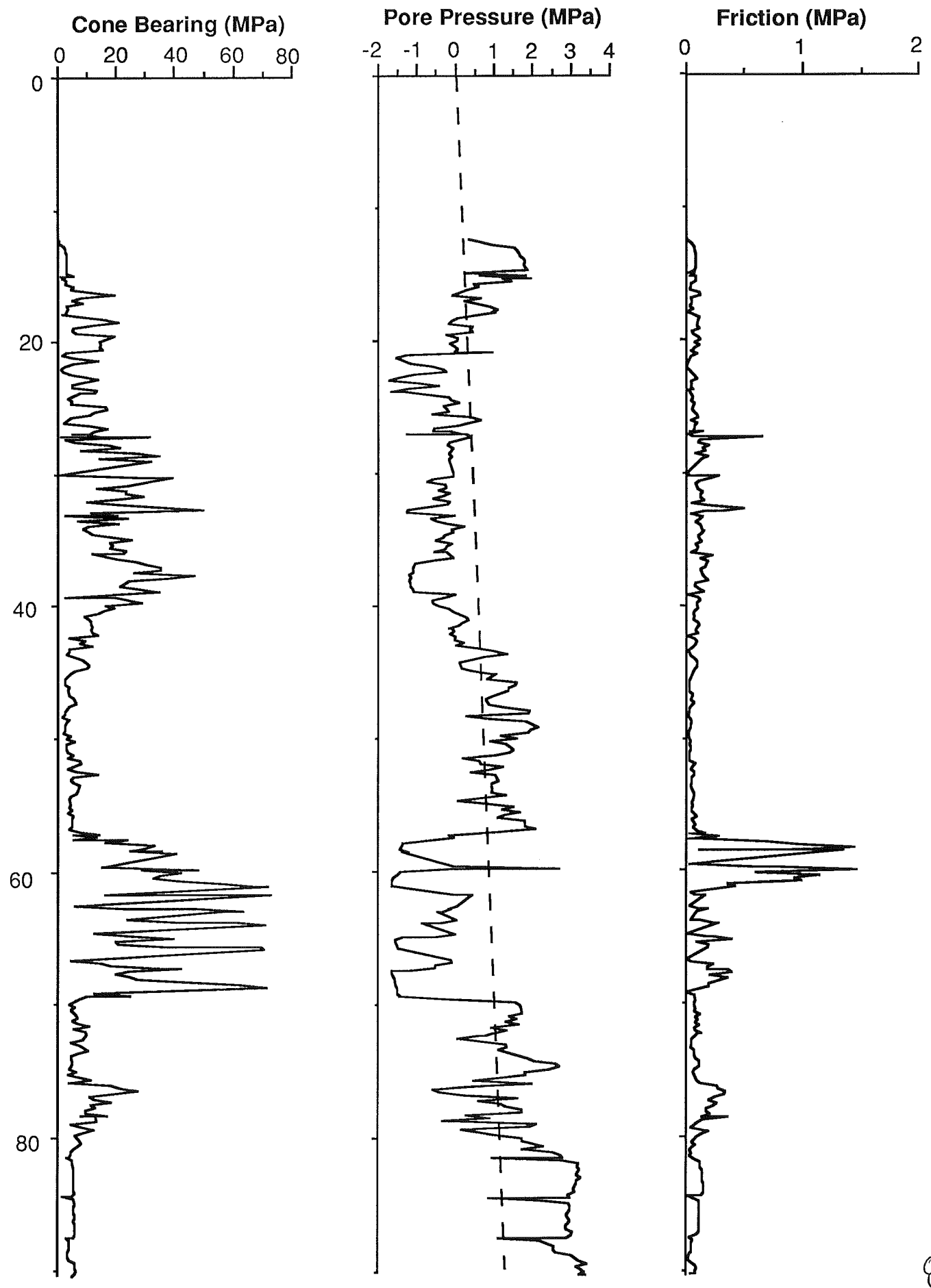

I-45
C-1A
W-1
88401-G1/G1A
0
10
20
30
40
50
60
70
80
90
100
110
120

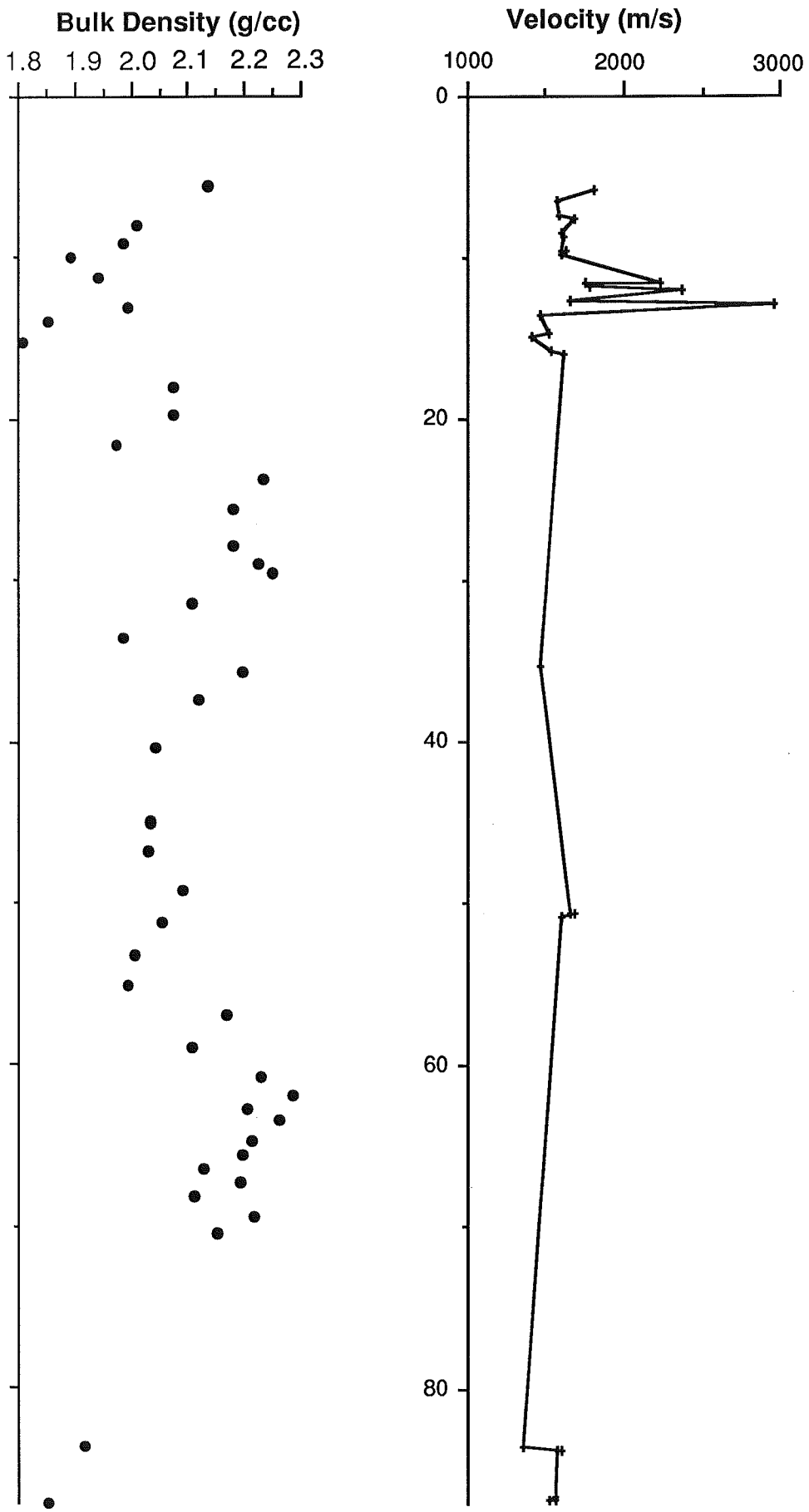

Hibernia B-08
Hibernia O-35
Ben Nevis I-45
Terra Nova K-18
DEPTH (METRES)
0
10
20
30
40
50
60
70
80
90
100

88400-06

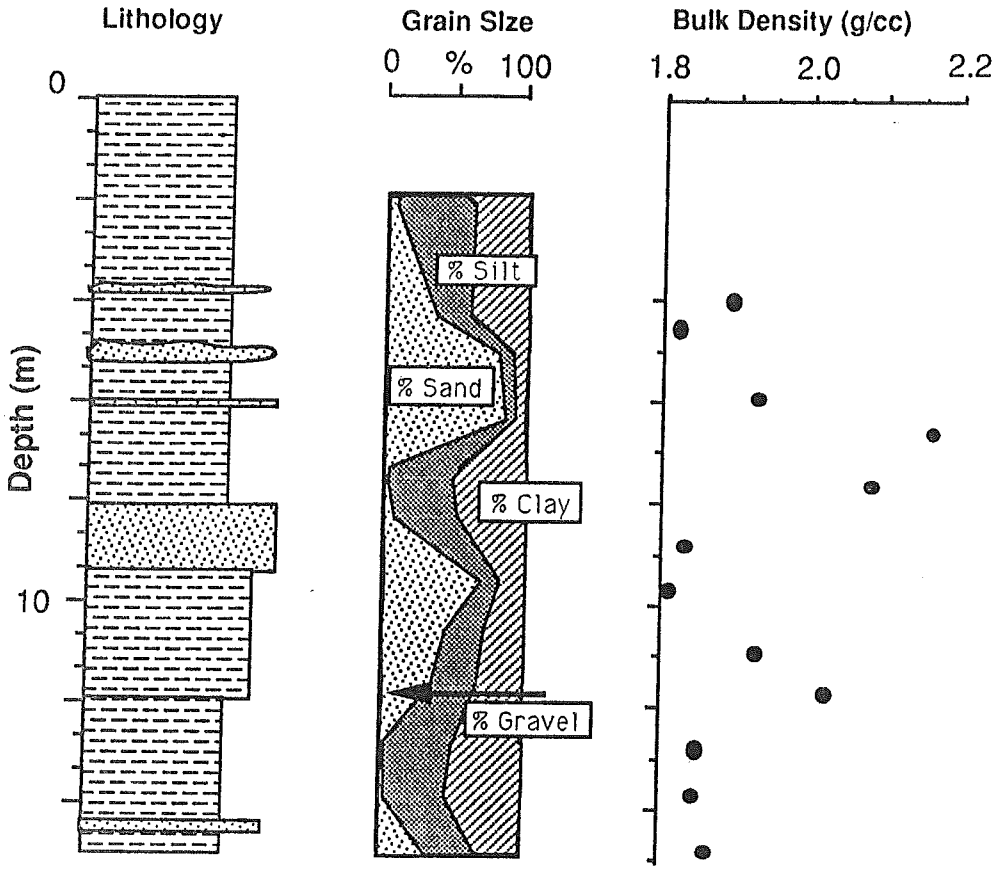

Lithology
Grain Size
0 % 100
% Clay
% Silt
% Sand
% Gravel
Grain Size (phi)
10 8 6 4 2 0
mean (phi)
mode
median
Depth (m)
0
20
40
60
80

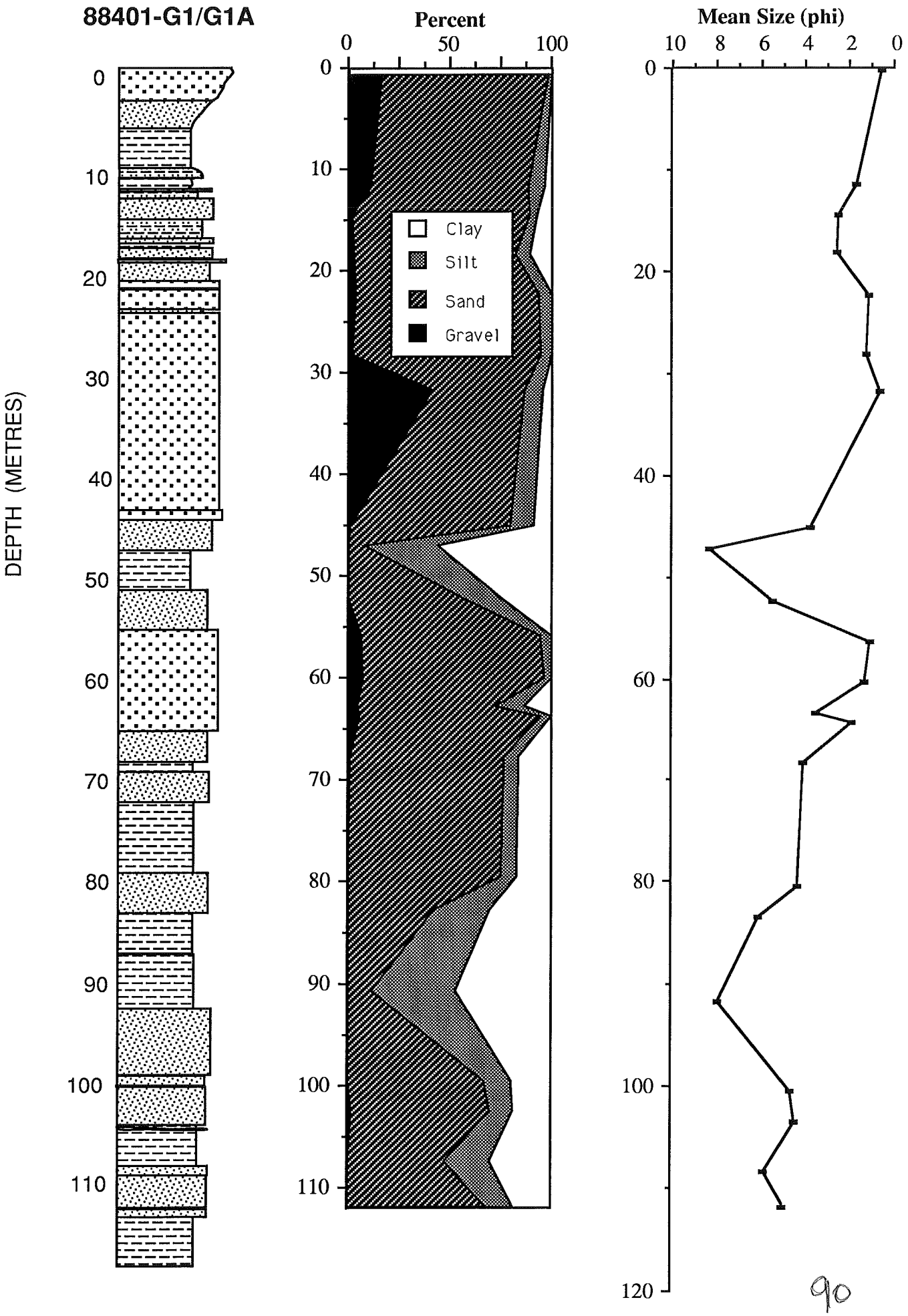

Coarsest Percentile (phi)
4
2
0
-2
-4
Standard Deviaton (phi)
4
3
2
1
0
Kurtosis and Skewness (dimensionless)
-5
0
5
10
15
20
kurtosis
skewness
depth (m)
0
10
20
30
40
50
60
70
80

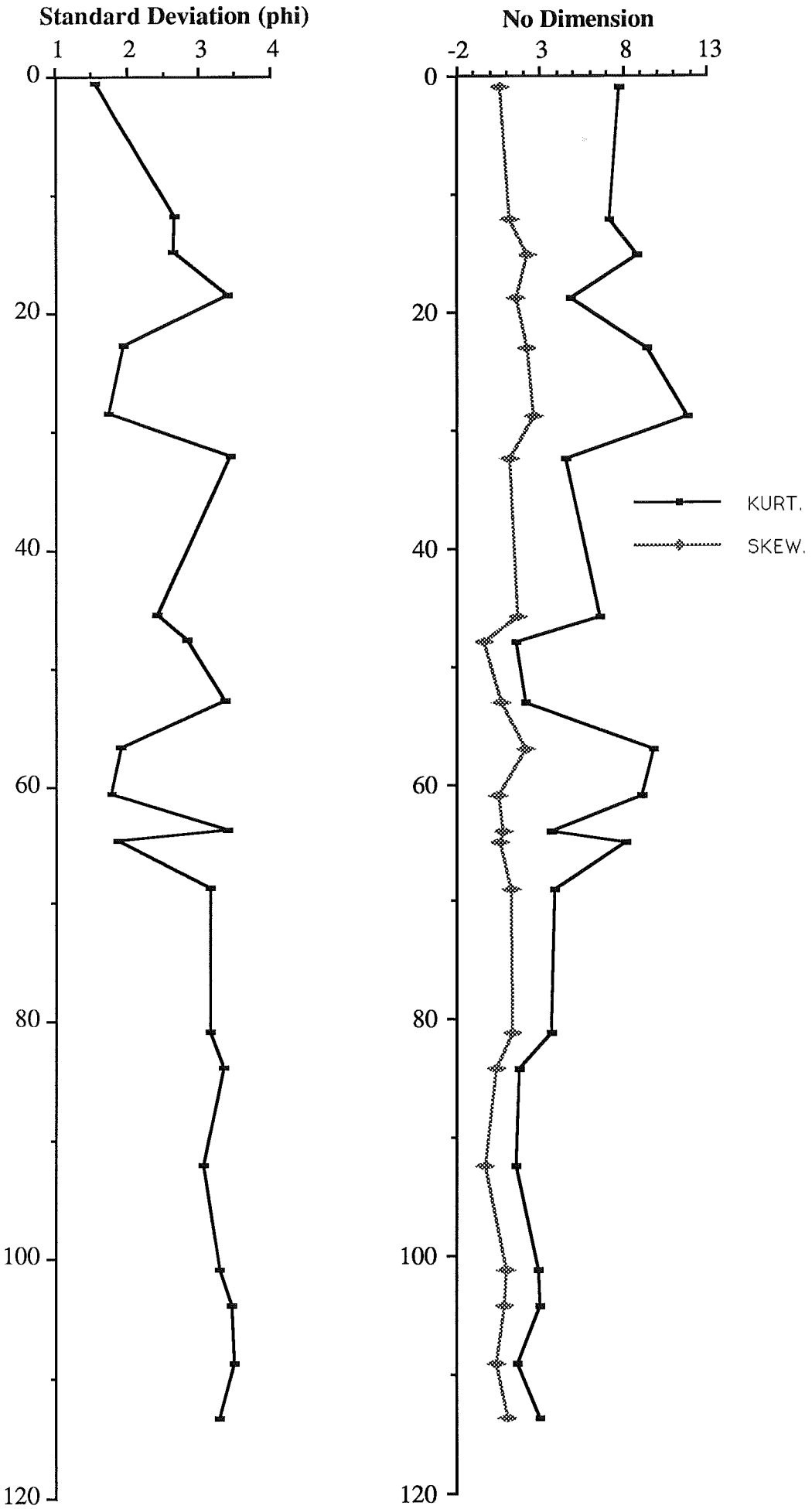

Cone Bearing (MPa)
0
20
40
60
80
0
20
40
60
80
Pore Pressure (MPa)
-2
-1
0
1
2
3
4
Friction (MPa)
0
1
2


Bulk Density (g/cc)
1.8
1.9
2.0
2.1
2.2
2.3
Velocity (m/s)
1000
2000
3000
0
20
40
60
80

88400-07


Lithology
Grain Size
0 % 100
Bulk Density (g/cc)
1.8
2.0
2.2
0
10
Depth (m)
% Silt
% Sand
% Clay
% Gravel


88401-G1/G1A
Percent
0
50
100
Mean Size (phi)
10
8
6
4
2
0
DEPTH (METRES)
0
10
20
30
40
50
60
70
80
90
100
110
120
Clay
Silt
Sand
Gravel


Standard Deviation (phi)
1
2
3
4
0
20
40
60
80
100
120
No Dimension
-2
3
8
13
KURT.
SKEW.