doi : 10.17596/0003005

Natsushima “Cruise Report”

NT13-19

Tsunami Prediction system:

Research Cruise in Japan Trench: Piston Coring

(Off Tohoku)

Aug.16th, 2013-Sept.4th, 2013

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

NT13-19 cruise report Contents

1. Cruise Information

Cruise ID: NT13-19
Name of vessel: NATSUSHIMA
Title of the cruise: Tsunami Prediction system: Research Cruise in Japan Trench
Chief scientist [Affiliation]: Toshiya Kanamatsu [IFREE-JAMSTEC]
Lead proponent [Affiliation] : Toshiya Kanamatsu [IFREE-JAMSTEC]
Title of proposal: Tsunami Prediction system: Research Cruise in Japan Trench: Coring research cruise
Cruise period: 16th, Aug. – 4th, Sept. 2013
Ports of call: Mutsu Sekinehama, JAMSTEC-Otaru
Research area: Off Tohoku
Research map: Fig. 1.1

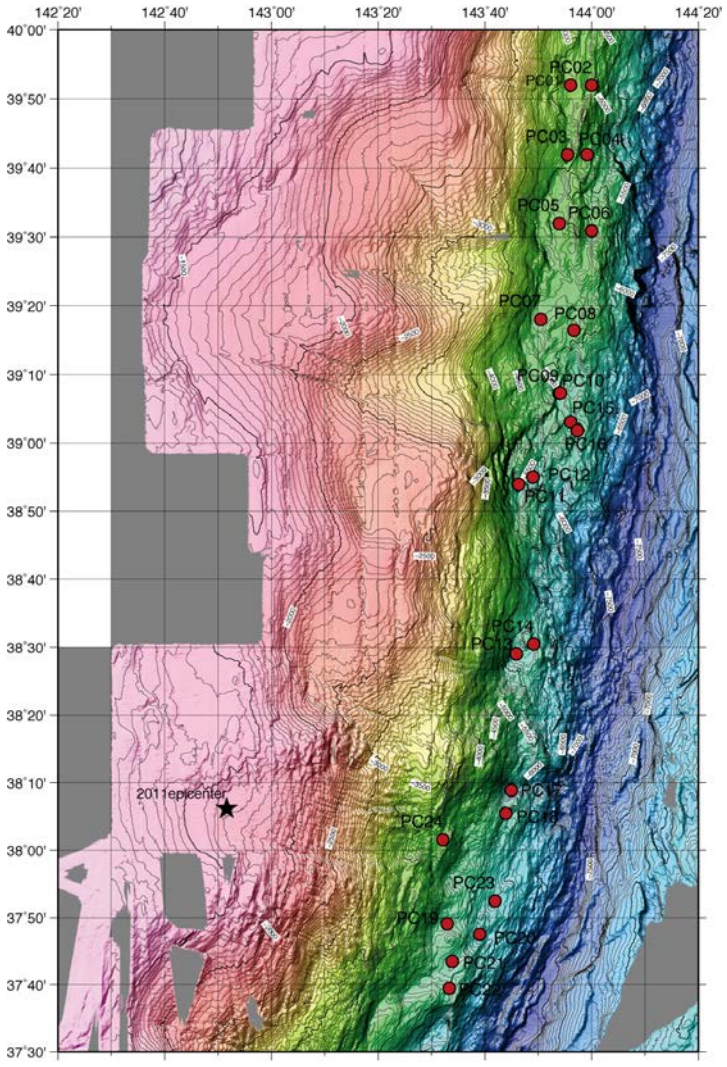

Fig.1.1: Locations of piston cores. Red circle: pistoncore position, black star shows location of 2011 tohoku earthquake epicenter.

2. Participant list

Scientific party

Toshiya Kanamatsu	JAMSTC
Cecilia McHugh	JAMSTEC/ Queens College, C.U.N.Y.
Kazuko Usami	AIST
Kazuhiro Yoshida	Marine Works Japan Ltd
Naotaka Togashi	Marine Works Japan Ltd
Yasushi Hashimoto	Marine Works Japan Ltd
Mika Yamaguchi	Marine Works Japan Ltd

R/V Natsushima Ship Crew

AOKI TAKAFUMI	Captain
ADACHI TATSUO	Chief Officer
TAKAHASHI TOMOYUKI	2nd Officer
IJICHI KAKERU	3rd Officer
SHIBATA HIROYUKI	Chief Engineer
KUROSE WATARU	1st Engineer
TADOOKA NAOHITO	2nd Engineer
IKUTA SHINITI	Jr.2nd Engineer
YOSHIMURA SHOGO	3rd Engineer
SUDA FUKUO	Chief Electronics Operator
KATAGIRI MICHIYASU	2nd Electronics Operator
HOSOKAWA SEIJI	Boat Swain
FUJII YOSHITSUGU	Able Seaman
KONNO YASUO	Able Seaman
NAGAI HIROAKI	Able Seaman
KAWAMURA KOSEI	Sailor
NAKANISHI TORU	Sailor
KAWABE YASUNOBU	Sailor
KOJIMA SHINYA	Sailor
IKEDA TOSHIKAZU	No.1 Oiler
SATO KAZUO	Oiler
AIZAWA KOTA	Oiler
TANIGUCHI KEIYA	Oiler
SUMITOMO SHOTARO	Oiler
YOSHIKAWA TERUYUKI	Chief Steward
KIRITA KOJI	Steward
OKADA YOSHIO	Steward
OHBA HIROYUKI	Steward
NAKANO MIZUKI	Steward

3. NT13-19 Cruise Log

2013	
Aug. 16	Left Mutsu-Institute for research area.
17	Coring at PC01 and PC02 sites
18	Coring at PC03 and PC04 sites
19	Coring at PC05 and PC06 sites
20	Coring at PC07 and PC8 sites
21	Coring at PC09 and PC10 sites
22	Coring at PC11 and PC12 sites
23	Coring at PC13 and PC14 sites
24	Coring at PC15 and PC16 sites
25	Coring at PC17 and PC18 sites
26	Coring at PC19 and PC20 sites
27	Coring at PC21 and PC22 sites
28	Coring at PC23 and PC24 sites
29	Wait on weather Aomori bay
30	Wait on weather off Hachinohe
31	Wait on weather in Aomori bay
Sept. 1	Wait on weather in Aomori bay
2	Transit to Otaru
3	Transit to Otaru
4	Arrival in endport of Otaru, end of expedition

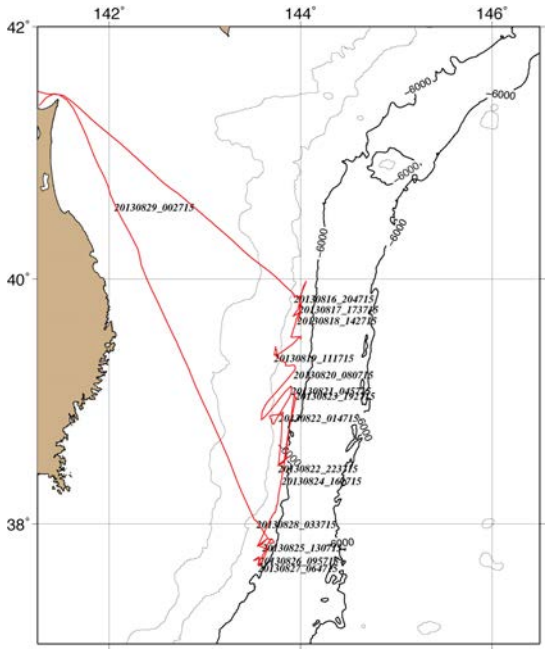

Figure 3.1. Ship track for NT13-19

4. Objective and summary of observation

4. 1. Objective and summary of observation

A long term prediction for earthquake in a subduction zone should be based on its recurrence interval and past displacements of a megathrust. Unfortunately no such research has been conducted in the deep Japan Trench subduction zone before the 2011 Tohoku earthquake. The recurrence of earthquakes could be understood by evaluating timing of event deposits in the sequences. In this study, not only in the trench axis where the most prominent displacement occurred, in the forearc basin and the landward slope areas. We first aim to document the evidence of the 2011 Tohoku-oki earthquake in the surface sediment, and then establish the earthquake recurrence in Tohoku-oki by identifying similar evidences in the past strata.

4.2. Overview of the Observation

Sampling and analyzing of event deposits formed by submarine landslides, displacement of faults, and strong motion during earthquakes, were planed to understand distribution of event deposit, and recurrence of earthquake. Sampling sites for piston corings were planed with referring to bathymetric and subbottom image records previously acquired in so-called mid slope terrace, Japan Trench. 24 cores were obtained (Fig.1.1). Major characteristic lithology recovered is Turbidite (Fig.4.1). These deposits are composed of very fine grained sand and coarse silt laminae and lenses and have sharp basal contacts above, the sandy deposit there is homogenous mud rich in silt and this homogeneous deposit has a top gradational contact that tends to be heavily bioturbated. In the central working area, we discovered fluidization or slump chaotic structure and overlaid by it is strikingly homogeneous with no evidence of bioturbation or sedimentary structures probably induced during 2011 earthquake.

Fig.4.1: Frequent occurrence of turbidite layers observed in PC21
(core diameter = ca. 74mm)

5. Instruments and Operation of Piston corer (MWJ)

Piston corer system (PC)

Piston corer system consists of 0.48 ton weight, 4 m or 8m long stainless steel barrels with polycarbonate liner tube and a pilot core sampler (Fig.5.1). Two types of piston: stainless steel body and Brass body type were used. Both of pistons are composing of two O-rings (size: P63). The inside diameter (I.D.) of polycarbonate liner tube is 74 mm. The total weight of the system is approximately 0.7 ton. The pipe length was chose based on site survey data and "K-value". For a pilot core sampler, we used a "74 mm diameter long-type pilot corer".

The transponder (OKI ltd. SB-1018; max depth 6,200 m) was attached to the winch wire above 50 m from the PC to monitor the PC position.

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"K-value"

"K-value" is the hardness barometer of the sea floor sediment. K value = pure pull out load / (outer diameter of outer pipe * penetration length). Because of winding power of the winch, we were requested to choose pipe length with referring "K-value".

		4 m piston coring	6 m piston coring	8 m piston coring
K value:	0.34 or less	OK	OK	OK
	0.34 ~ 0.46	OK	OK	NG
	0.46 ~ 0.74	OK	NG	NG

Winch operation

When we started lowering PC, a speed of wire out was set to be 20 m/min, and then gradually increased to the maximum of 60 m/min. Lowering was stopped at a depth about 100 m above the seafloor. 3 minutes were spend to reduce some pendulum motion of the system. After stabilizing the corer motion, the wire was wound out again at a speed of 20 m/min. When the corers touched the bottom, the wire tension abruptly decreased by the loss of the corer weight. Immediately after confirmation that the corers hit the bottom, wire out was stopped and winding of the wire was started at a speed of 20m/min, until the tension gauge indicates that the corers were lifted off the bottom. After left the bottom, winch wire was wound in at the maximum speed.

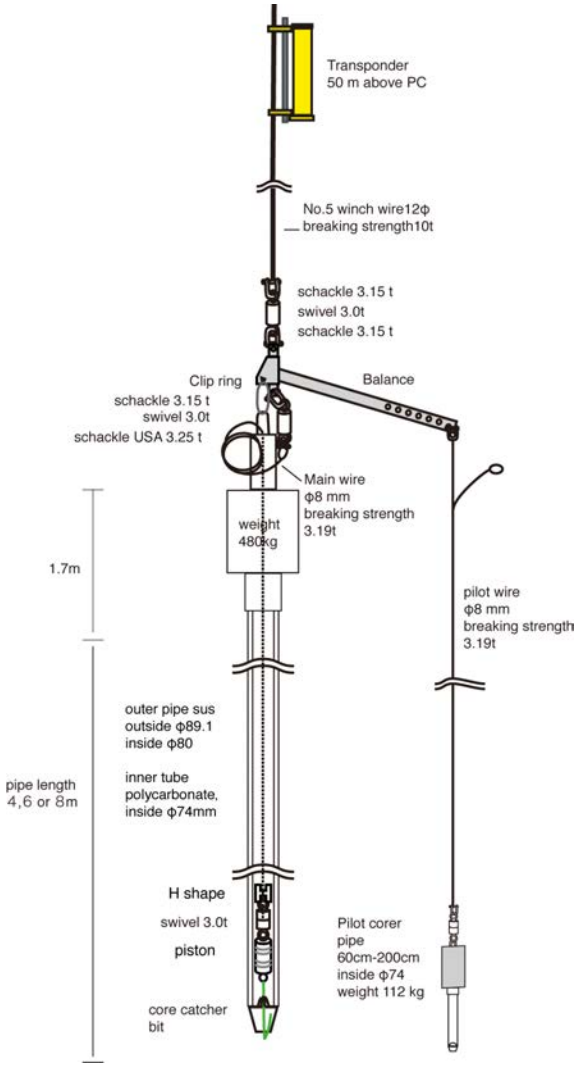


Figure 5.1 piston corer system

Core splitting

The sediment sections are longitudinally cut into working and archive halves by a splitting devise and a nylon line or a stainless wire.

6. Piston core preliminary Results

6.1. Site information for PC point and Section length of each core

All information of PCs sites and recovery rate and length are summarized in Table 6.1.1.

Table 6.1.1 Coring Summary of NT13-19 cruise

Date (UTC) (yymmdd)	Core ID	Corer type*	Location	Lat.（TP**）	Lon.（TP**）	Lat.（Ship）	Lon.（Ship）	Depth (m)	Corebarrel length (m)	Tension max. (kN)	K value***	Core length（cm）****
2013/8/16	PC01	Inner type PC	Off Tohoku (St.01:1_a)	39°51.9590'N	143°56.0560'E	39°51.9842'N	143°55.9630'E	4,281	4	31.0	0.06	259.5
	PL01	74 diam. corer							0.7			84.0
2013/8/17	PC02	Inner type PC	Off Tohoku (St.02:2_a)	39°51.9704'N	144°00.0137'E	39°52.0178'N	143°59.9797'E	4,450	6	33.9	0.07	552.0
	PL02	74 diam. corer							0.7			85.0
2013/8/17	PC03	Inner type PC	Off Tohoku (St.03:3_a)	39°41.9244'N	143°55.4821'E	39°42.0060'N	143°55.5336'E	4,548	4	35.2	0.13	269.7
	PL03	74 diam. corer							0.7			0.0
2013/8/18	PC04	Inner type PC	Off Tohoku (St.04:4_a)	39°41.9525'N	143°59.1968'E	39°42.0263'N	143°59.2202'E	4,734	6	37.1	0.10	507.0
	PL04	74 diam. corer							0.7			0.0
2013/8/18	PC05	Inner type PC	Off Tohoku (St.05:6_a)	39°31.9707'N	143°53.9958'E	39°32.0284'N	143°53.9970'E	4,664	4	35.6	0.13	375.5
	PL05	74 diam. corer							0.7			117.4
2013/8/19	PC06	Inner type PC	Off Tohoku (St.06:9_a)	39°30.9067'N	143°59.9871'E	39°31.0151'N	144°00.0040'E	4,874	6	36.9	0.10	530.0
	PL06	74 diam. corer							0.7			100.0
2013/8/19	PC07	Inner type PC	Off Tohoku (St.07:11_a)	39°18.0027'N	143°50.4959'E	39°18.0564'N	143°50.5317'E	4,826	4	35.0	0.08	290.0
	PL07	74 diam. corer							0.7			111.8
2013/8/20	PC08	Inner type PC	Off Tohoku (St.08:12_c)	39°16.4448'N	143°56.6842'E	39°16.4902'N	143°56.7053'E	4,983	6	37.8	0.09	546.9
	PL08	74 diam. corer							0.7			103.0
2013/8/20	PC09	Inner type PC	Off Tohoku (St.09:D141W)	39°07.2109'N	143°53.9452'E	39°07.3167'N	143°53.9000'E	5,375	4	41.7	0.18	363.8
	PL09	74 diam. corer							0.7			78.4
2013/8/21	PC10	Inner type PC	Off Tohoku (St.10:D141E)	39°07.2353'N	143°54.1586'E	39°07.2855'N	143°54.2419'E	5,398	6	40.3	0.09	542.7
	PL10	74 diam. corer							0.7			56.5
2013/8/21	PC11	Inner type PC	Off Tohoku (St.11:20_b)	38°53.9519'N	143°46.3720'E	38°54.0419'N	143°46.3161'E	5,534	4	38.2	0.07	341.0
	PL11	74 diam. corer							0.7			91.0
2013/8/22	PC12	Inner type PC	Off Tohoku (St.12:18_a)	38°54.9813'N	143°49.0229'E	38°55.0633'N	143°48.9234'E	5,656	6	42.2	0.13	560.2
	PL12	74 diam. corer							0.7			93.5
2013/8/22	PC13	Inner type PC	Off Tohoku (St.13:27_b)	38°28.9814'N	143°45.9449'E	38°29.0338'N	143°45.9909'E	5,651	4	39.1	0.07	296.6
	PL13	74 diam. corer							0.7			91.5
2013/8/23	PC14	Inner type PC	Off Tohoku (St.14:30_d)	38°30.4596'N	143°49.1317'E	38°30.5459'N	143°49.2258'E	5,592	6	43.2	0.12	553.3
	PL14	74 diam. corer							0.7			36.0
2013/8/23	PC15	Inner type PC	Off Tohoku (St.15:15_b)	39°03.0483'N	143°56.0808'E	39°03.0086'N	143°55.9885'E	5,437	4	37.9	0.06	352.3
	PL15	74 diam. corer							0.7			67.0
2013/8/24	PC16	Inner type PC	Off Tohoku (St.16:15_a)	39°01.7839'N	143°57.3741'E	39°01.7777'N	143°57.4828'E	5,547	6	39.0	0.06	540.1
	PL16	74 diam. corer							0.7			67.3
2013/8/24	PC17	Inner type PC	Off Tohoku (St.17:32_c)	38°08.8664'N	143°44.9466'E	38°08.9976'N	143°45.0114'E	5,848	4	41.4	0.10	327.4
	PL17	74 diam. corer							0.7			62.5
2013/8/25	PC18	Inner type PC	Off Tohoku (St.18:33_c)	38°05.4292'N	143°43.9558'E	38°05.5124'N	143°43.9969'E	5,496	6	40.7	0.09	555.9
	PL18	74 diam. corer							0.7			82.0
2013/8/25	PC19	Inner type PC	Off Tohoku (St.19:40_c)	37°49.0863'N	143°32.9676'E	37°49.0119'N	143°32.9965'E	5,329	4	39.3	0.12	351.2
	PL19	74 diam. corer							0.7			56.5
2013/8/26	PC20	Inner type PC	Off Tohoku (St.20:41_c)	37°47.5223'N	143°39.0812'E	37°47.5287'N	143°39.0192'E	5,720	6	42.0	0.10	477.1
	PL20	74 diam. corer							0.7			74.3
2013/8/26	PC21	Inner type PC	Off Tohoku (St.21:42_c)	37°43.5055'N	143°33.9127'E	37°43.5185'N	143°34.0047'E	5,447	4	36.3	0.02	314.8
	PL21	74 diam. corer							0.7			55.6
2013/8/27	PC22	Inner type PC	Off Tohoku (St.22:45_c)	37°39.4379'N	143°33.3305'E	37°39.5011'N	143°33.5249'E	5,409	6	41.0	0.12	553.9
	PL22	74 diam. corer							0.7			67.5
2013/8/27	PC23	Inner type PC	Off Tohoku (St.23:38_c)	37°52.4376'N	143°41.8890'E	37°52.5172'N	143°41.9569'E	5,875	4	39.4	0.04	322.8
	PL23	74 diam. corer							0.7			63.5
2013/8/28	PC24	Inner type PC	Off Tohoku (St.24:35_c)	38°01.5548'N	143°32.1347'E	38°01.5202'N	143°32.1447'E	4,385	4	34.8	0.16	358.2
	PL24	74 diam. corer							0.7			48.5

*Weight of the PC is 480 kg.

**"TP" is position by the transponder.

***K value is the strength barometer of the sea floor sediment; K value = pure pull out load / (outer diameter of outer pipe * penetration length).

****Core length is mesured after 1m cut.

6.2. Setting of working area

The most characteristic morphological feature in the slope of Japan Trench is a long elongated terrace parallel to the trench axis with 4000-5000 water depth. The terrace, so-called mid slope terrace [Cadet et al., 1987a], located between an upper slope and a lower slope has gentle slope as only 2° [von Huene and Lallemand , 1990]. One of the main objectives was to begin to understand the sedimentation in this area that had not been previously cored except for Deep Sea Drilling Leg 56 and 57. Previous studies have documented active faults that cross the mid-slope terrace [Kawamura et al., 2012, Tsuji et al., 2013]. The mid-slope terrace contains many small basins, which may capture mass transport deposits induced by earthquakes from an up-slope. An investigation on such surface sediment in these basins, therefore, will provide an opportunity for determining recurrence of earthquakes in Tohoku. In order to characterize the sediment deposited in these basins, we planed a piston coring campaign in August 2013 in the following working areas (Fig. 6.2.1): A) north mid slope terrace (39°10'N-40°N), characterized by small elongated basins of which major axes of basins are NE-SW (4000-5000m) (Iwabuchi et al., 1996). B) Small basins with no systematic trend are located between 39°N to 39°40' N and in water depths of 5000-6000 m (Sasaki 2004). C) Epicenter area of 2011 Tohoku earthquake extending from 38°30'N to 38°N and in water depths of 5000-6000m, and D) lower slope extending from 38°N to 37°30'N and with water depths between 5000 and 6000 m The basins in the northern study area are 10's of meters deep and are commonly bounded by a steep and up to 500 m high scarp, which suggests that faults nearby are present and they may be active. To test for synchronicity of events basins that are proximal but upslope and downslope from each other were sampled. To begin to understand segmentation along the Japan Trench, the sampling strategy also involved coring basins along the strike of the trench. The axis of the basins on the second study area do not follow a NE-SW trend as do the basins on the northern study area. The terrace along this study area also deepens from 5000 to 6000 m of water depth from 39°N to 39° 40'N. This area was described in the Tsuji et al. (2013) as a "backstop" and compression. The sampling strategy for this region focused on those basins that the multibeam bathymetry showed had pronounced depth and were bounded by steep scarp.

The study area downslope from the 2011 Tohoku oki earthquake extended from was targeted for three main reasons. 1) activity in normal fault basins that have been associated to the tsunami source (Tsuji et al 2013) 2) downslope for evidence of mass-wasting and turbidity currents related to the earthquake and to potentially prior earthquakes to begin to evaluate recurrence interval along this segment of the trench. 3)

Prior studies have shown that ash layers were present in the normal fault basins and mid-slope terrace sediment, therefore this area seemed like a good target for developing a tephra chronology (SO219 cruise report). The fourth study area extends from approximately 38°N to 37°30'N and was the deepest of all the four areas with water depths between 5000 and 6000 m. Morphologically it is a flat area and the basins have similar NE-SW trending orientation of their main axis. These basins are not as deep as those of the northern study area and the bounding scarps are not as high as those of the northern study area.

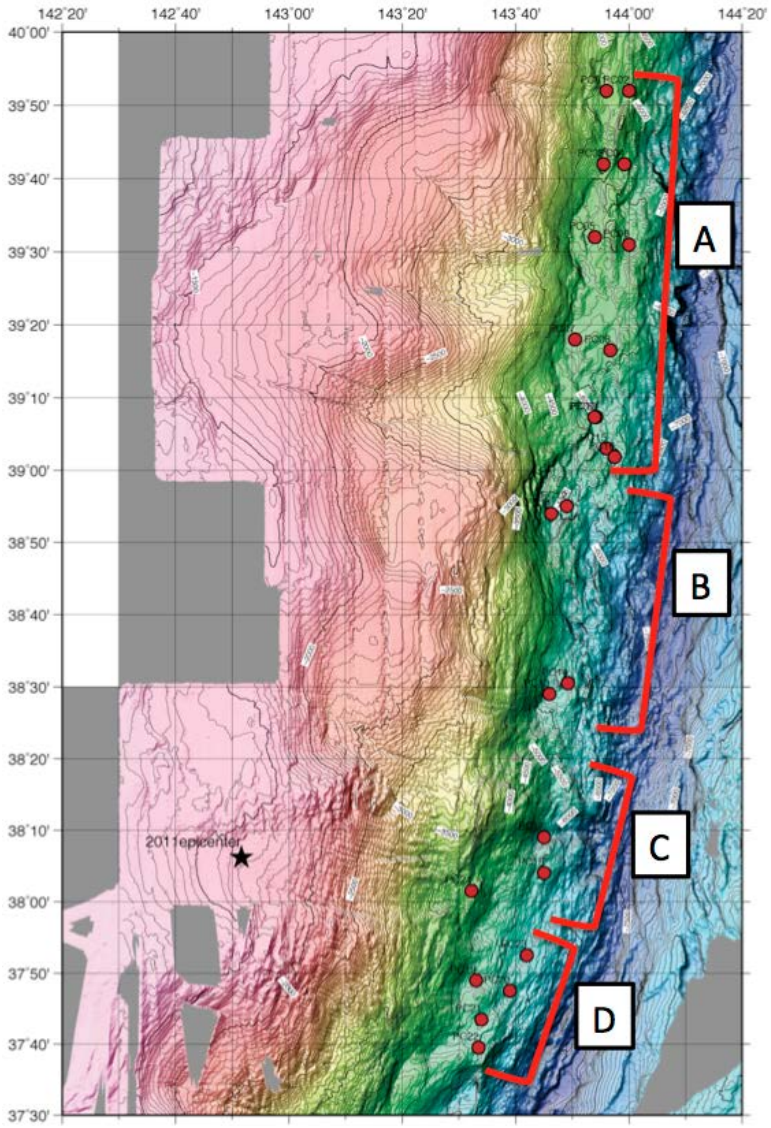


Fig. 6.2.1. Location of working areas A,B,C, and D. See test for their details

6.3. Initial Results:

Study Area A:

Turbidites and turbidite-homegnites characterize the sedimentation of these basins. These deposits are composed of very fine grained sand and coarse silt laminae and lenses and have sharp basal contacts, above Above, the sandy deposit there is homogenous mud rich in silt and this homogeneous deposit has a top gradational contact that tends to be heavily bioturbated. We are calling these turbidites as turbidite-homogenite units that have been previously documented in other tectonic settings and associated to historic and pre-historic earthquakes. For example in the Marmara Sea to the North Anatolia Fault (Cagatay et al. 2012) and in the Enriquillo-Plantaint Garden transform boundary in Haiti (McHugh et al. 2011). The initial interpretation is that turbidites were caused by earthquakes and that the homogeneous deposit most likely represents the settling of suspended sediment triggered by the event. In other settings this homogeneous deposit also called "homogenite" has taken several months to settle onto the seafloor. Post-cruise analyses such as grain size, core x-radiographs and x-ray fluorescence geochemical elemental analyses calibrated to an age model will provide further information that will permit linking the turbidites to earthquakes.

Study Area B:

An unusually thick and structureless deposit was recovered from the upper meter in our second study area. This deposit it is composed of clayey silt as most of the sediment recovered but it is strikingly homogeneous with no evidence of bioturbation or sedimentary structures. Short-lived radioisotope dating will determine if there is a link with the 2011 event. Most importantly, the 6-meter core had at least three such meter-thick homogenous deposits. Future analyses will try to determine if the depositional process is linked to fluidization by earthquakes or other sedimentation process and if this is characteristic to the backstop compressive study area. Fluidization structures were found in two other cores in this study area as well.

Study Area C:

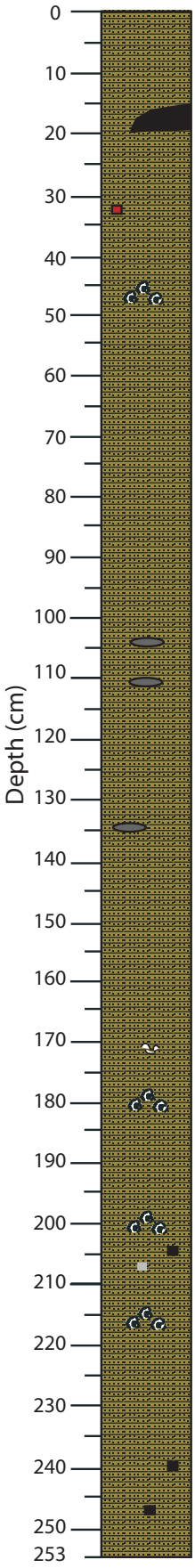
Downslope from the 2011 epicentral region we found substantial evidence for the earthquake, that of course need to be verified by age dating. But lithologically the upper meter 70 cm of PC23 we found massive homogeneous sandy silt with a brownish band a few centimeters thick. A similar color band characterized the Tohoku event in cores recovered from the trench. The lower slope cores have abundant sand and near the top of the core the sand is disseminated in the clayey silt.

Study Area D:

The cores on the southernmost study area have the most sand as sand beds, laminae, lenses and disseminated sand. The character of sand is slightly different in that it is coarser grained. Additionally basal contacts are sharp and in some instances “v”-shaped suggestive of energetic flows scaouring the sediment benath. Further analyses will try to identify the source of the sand and why is it coarser than in the other study areas.

All shipboard simplified lithologic columns are presented in the next section.
Note PC24 and PL24 were not split onboard because their whole round will be used for OSL measurement, then no description in this report.

NT13-19-PC01- Sections 1, 2, 3



Latitude:
Longitude:
Core length: 253 cm
Water Depth:
Date taken: 8/17/13
Date opened: 8/18/13
Date described: 8/18/13
Date photographed: 8/18/13
Described by: McHugh
Flow-in: no

0-253 cm [Diatomaceous Clayey Silt], grayish olive (7.5Y 4/2)
From 0 - 253 cm homogeneous diatomaceous clayey silt
From 0 - 8 cm soupy
At 17 - 22 cm black mottling (7.5Y 2/1)
At 32.5 cm subangular granule (puice?

From 47 to 48 cm rare, scattered forams

Rare scattered forams from 58 to 158 cm

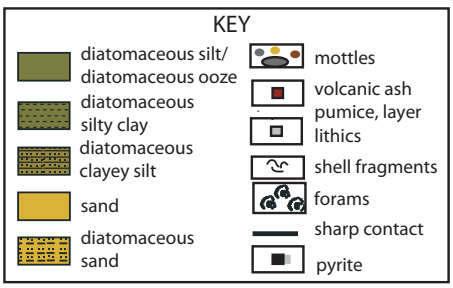
Mottling black (7.5Y 2/1) at
105-107 cm
112-114 cm
135-137 cm

At 179 cm shell fragment

Lithic subrounded granule at 207 cm

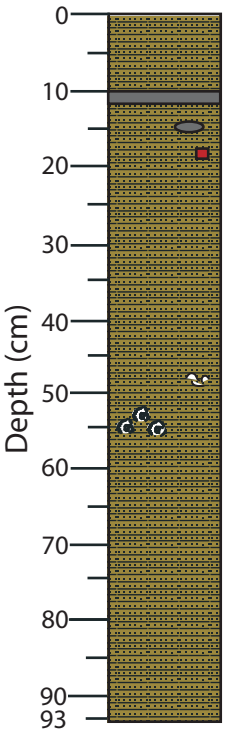
Possible pyrite (black 7.5Y 6/1) at 203 cm, 240 cm, 247 cm

Rare, scattered forams at:
180 - 181 cm, 194 - 200 cm, 212 - 216 cm.



NT13-19-PL01 Sections 01, CC

Latitude: Longitude:
Core length: 93 cm Water Depth:
Date taken: 8/18/13 Date opened: 8/18/13
Date described: 8/18/13 Date photographed: 8/18/13
Described by: McHugh Flow-in: no

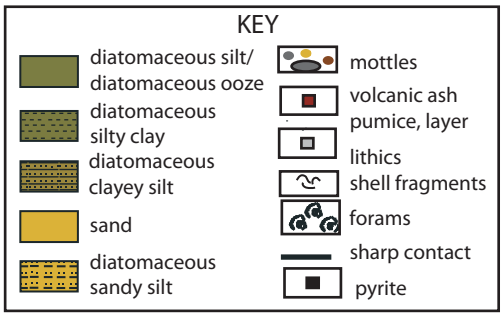


0-93 cm [Diatomaceous Clayey Silt], grayish olive (7.5Y 4/2)

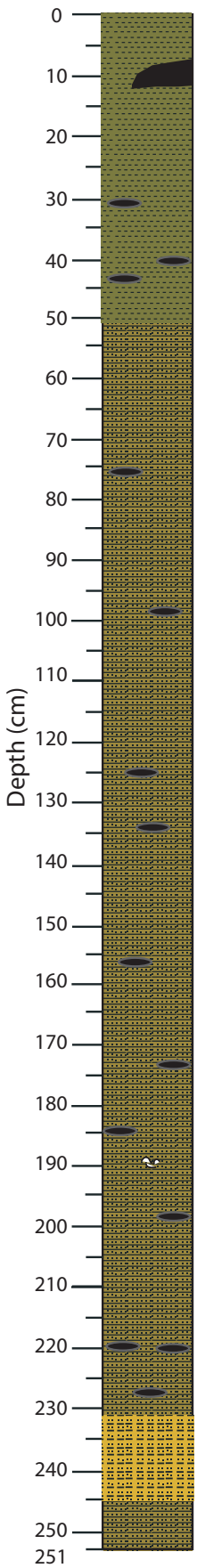
From 10 - 11 cm, 16 cm mottles black (7.5Y2/1)
At 19 cm granule (pumice?), subangular

At 50.5 cm shell fragment (mm scale)

From 54-57 cm foram patch



NT13-19-PC02- Sections 1, 2, 3



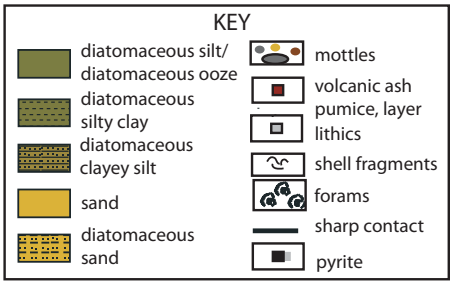
Latitude:
Core length: 548 cm
Date taken: 8/19/13
Date described: 8/19/13
Described by: McHugh

Longitude:
Water Depth:
Date opened: 8/19/13
Date photographed: 8/19/13
Flow-in: no

0-51 cm [Diatomaceous Silty Clay], grayish olive (7.5Y 4/2)

From 0 - 6 cm soupy
Color banding : black (7.5Y2/1) at:
9-12 cm, 30-31 cm, 41-42 cm, 44-45 cm

51 - 151 cm [Diatomaceous Clayey Silt], dark olive (7.5Y 4/3)
Mottling and color banding: black (7.5Y 2/1) at: 76 -80 cm, 99-100 cm, 123-126 cm, 133-135 cm



151-205 cm [Diatomaceous Clayey Silt], dark olive (7.5Y 4/3)
Mottling and color banding black (7.5Y 2/1)
157-158 cm, 159-160 cm, 174-176 cm, 178-180 cm,
185-186 cm, 188- 190 cm, 196-197 cm

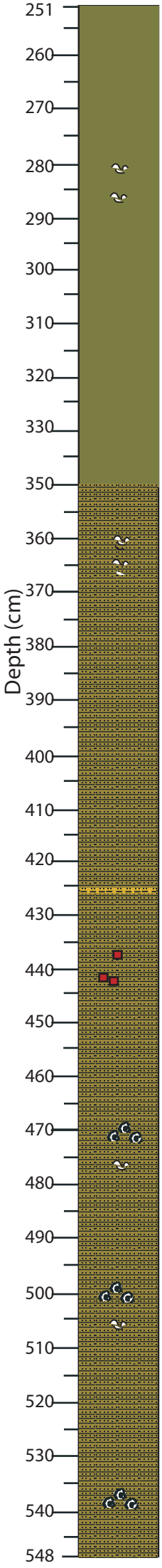
Pocket of shell fragments at 193 cm

205-251 cm [Very fine sand in Diatomaceous Silt], dark olive (7.5Y 4/3)

Very fine sand laminae with sharp contacts present at:
233 cm, 234 cm, 235 cm, 238-240 cm, 245 cm

Scattered very fine sand from 246 - 251 cm

Also present mottling and color banding, black (7.5Y 2/1) at:
219-220 cm, 222-223 cm, 224-225 cm,
228-229 cm, 230-231 cm



NT13-19-PC02- Sections 4, 5, 6, CC

Latitude:
Core length: 548 cm
Date taken: 8/19/13
Date described: 8/19/13
Described by: McHugh

Longitude:
Water Depth:
Date opened: 8/19/13
Date photographed: 8/19/13
Flow-in: no

251-351 cm [Diatomaceous Silt], dark olive (7.5Y 4/3)

The diatomaceous silt contains intervals of v.f. sand at: 251-256 cm, 281-291 cm, 306-311cm, 321-326 cm

Shell fragments 283 cm, 286 cm

Color mottling and banding throughout 251cm to 351 cm: black (7.5Y 2/1)
267 - 268 cm, 287 - 289 cm, 295- 297 cm, 317-318 cm, 336 - 337 cm, 344-345 cm

351 - 451 cm [Diatomaceous Clayey Silt], dark olive (7.5Y 4/3)

Shell fragments at 360 - 362 cm
At 424 cm possibly a mm-size glass shard
Ash pockets at: 437-438 cm, 442 - 444 cm

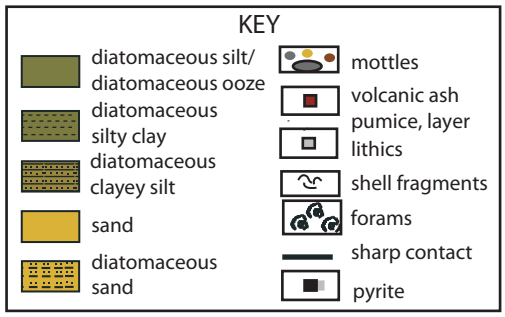
Color banding and mottling: black (7.5Y 2/1) at:
367 - 371, 385-390 cm, 401 - 404 cm, 407 cm, 444-446 cm.

From 405 - 426 cm color change to olive black (7.5Y 3/1). Very sharp contacts above and below the color change zone. At the base at 426 cm there is a very fine sand lamina

From 451 to 548 [Diatomaceous Clayey Silt], dark olive (7.5Y 4/3)

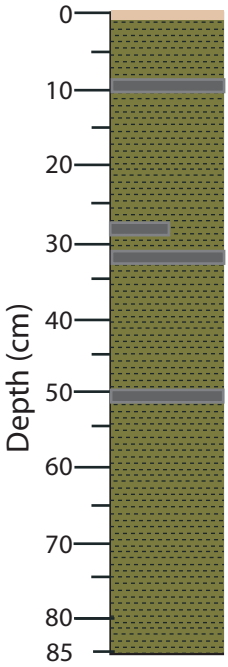
Shell fragments and forams? at
473-475 cm, 503 cm, 505 cm, 538 cm.

Mottling and color banding throughout
451 and 548 cm. Color ranges from olive black
(7.5Y 3/1) to grayish olive (8.5Y 5/2).



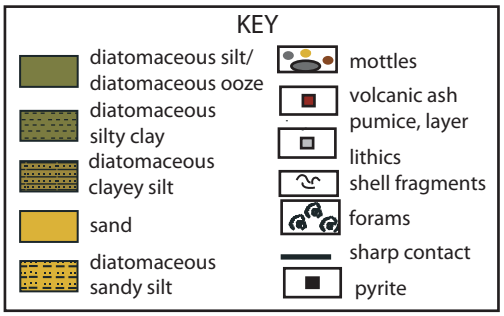
NT13-19-PL02

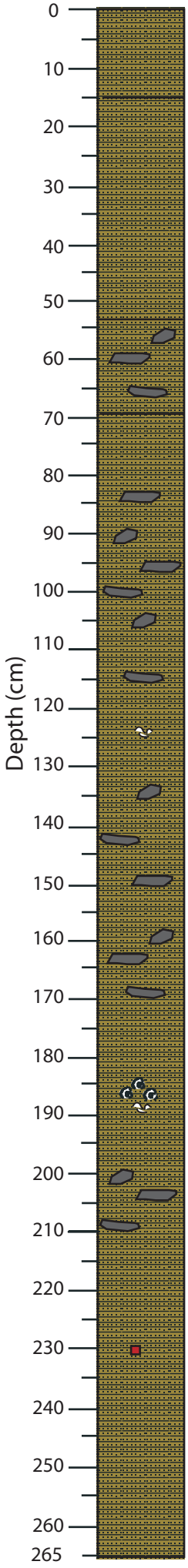
Latitude: Longitude:
Core length: 85 cm Water Depth:
Date taken: 8/19/13 Date opened: 8/19/13
Date described: 8/19/13 Date photographed: 8/19/13
Described by: McHugh Flow-in: no



0-85 cm [Diatomaceous Silty Clay], grayish olive (7.5Y 4/2)
From 0- 85 cm homogeneous diatomaceous silty clay

Color banding
0 - 0.5 cm dark grayish yellow (2.5Y4/2)
At 8-9 cm, 27-28 cm, 32-33 cm, 51-52 cm black (7.5Y 2/1)





NT13-19-PC03- Sections 1, 2, 3

Latitude:
Core length: 265 cm
Date taken: 8//13
Date described: 8/20/13
Described by: McHugh

Longitude:
Water Depth:
Date opened: 8/20/13
Date photographed: 8/20/13
Flow-in: no

0-265 cm [Diatomaceous Clayey Silt]
From 0 - 15 cm soupy
From 0 to 54 cm dark olive (7.5Y 4/3)
From 54 - 60 cm olive black (7.5Y 3/2)
Mottling and color banding from 54 to 69 cm olive black 7.5Y 2/2

Color from 70 - 82 cm: olive black (10Y 3/1), color band at 82 cm black (10Y 3/2)

Heavy bioturbation: 83-93 cm, 99-103 cm, 109-144 cm

Possible shell fragment at 126 cm

From 141-168 cm clayey silt olive black 7.5Y 3/2

From 168 to 265 cm Diatomaceous Clayey Silt heavily bioturbated.
Color mottling throughout due to bioturbation ranging from:
grayish olive (7.5Y 4/2), olive black (7.5Y 3/2), black (7.5Y 2/1)

Pocket of shells 187 - 188 cm

At 227 cm granule of pumice, white, subangular

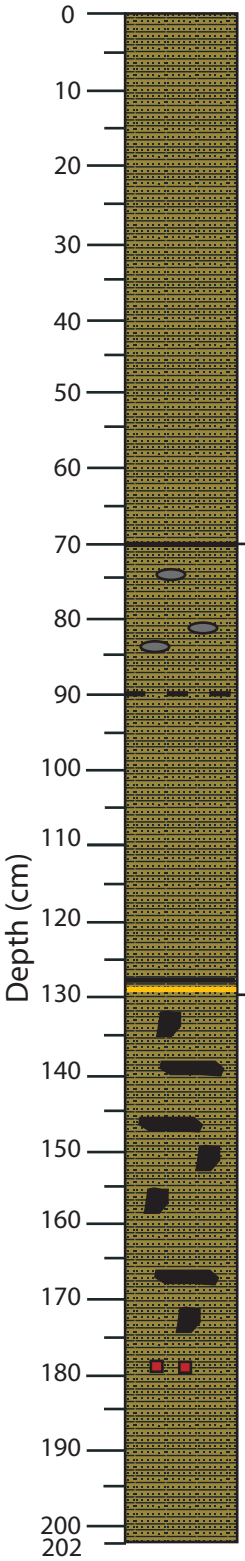
KEY

- diatomaceous silt/ diatomaceous ooze
- diatomaceous silty clay
- diatomaceous clayey silt
- sand
- diatomaceous sand
- mottles
- volcanic ash
- pumice, layer
- lithics
- shell fragments
- forams
- sharp contact
- pyrite

NT13-19-PC04- Sections 1, 2, 3

Latitude:
Core length: 502 cm
Date taken: 8/18/13
Date described: 8/21/13
Described by: McHugh

Longitude:
Water Depth:
Date opened: 8 / 2 1 / 1 3
Date photographed: 8 / 2 1 / 1 3
Flow-in: no



0 - 202 cm [Diatomaceous Clayey Silt], dark olive (7.5Y 4/3)
From 0 - 9 cm soupy

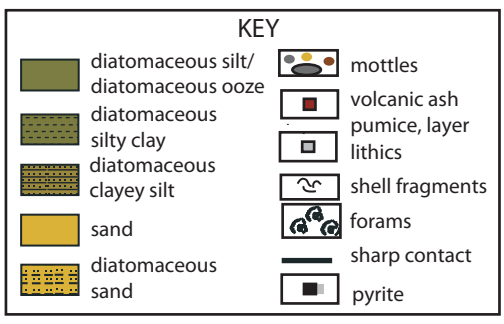
From 70 to 90 cm mottling (bioturbation), grayish olive (7.5Y 4/2)

From 90 - 127 cm [Diatomaceous Clayey Silt] homogeneous,
color change to olive black (7.5Y 3/1)

At 127 sharp contact. Below the contact at 128 cm very fine sand lamina

From 129- 196 cm intervals of mottling (bioturbation), black (10Y 2/1) at:
128 - 138 cm, 142-158 cm, 165 - 174 cm.

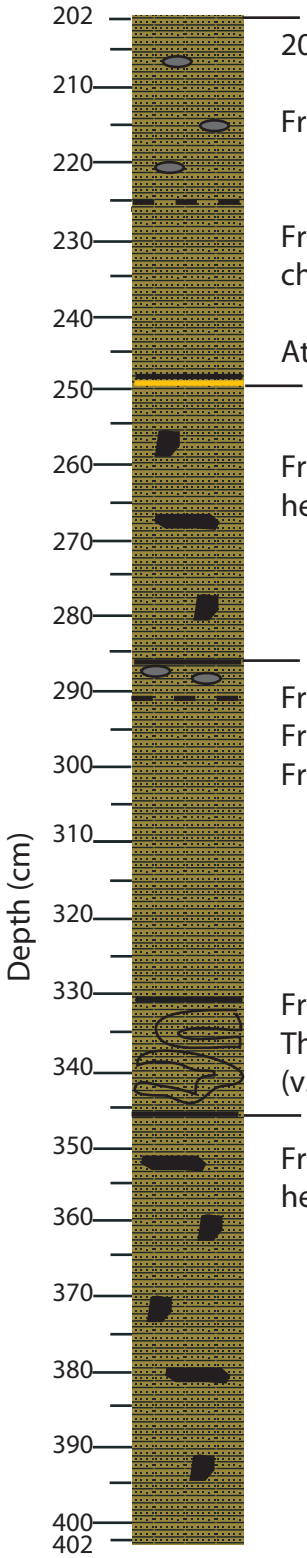
At 180 cm two pebbles (pumice?), light gray (7.5Y 7/1), subangular



NT13-19-PC04- Sections 3, 4

Latitude:
Core length: 502 cm
Date taken: 8//13
Date described: 8/21/13
Described by: McHugh

Longitude:
Water Depth:
Date opened: 8/21/13
Date photographed: 8/21/13
Flow-in: no



202 - 248 cm [Diatomaceous Clayey Silt], grayish olive (7.5Y 4/2)

From 202 - 227 cm, mottling (bioturbation), olive black (7.5Y 3/2)

From 227 - 247 [Diatomaceous Clayey Silt], homogeneous
change color to olive black (7.5Y 3/2)

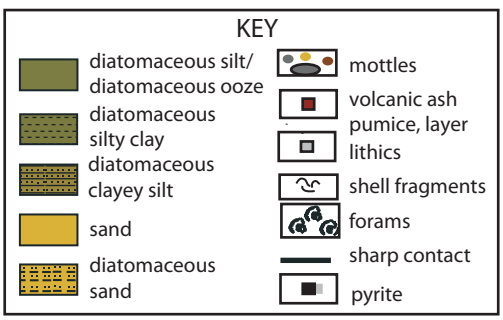
At 248 cm sharp contact. Below very fine sand laminae at 248.5 and 249 cm

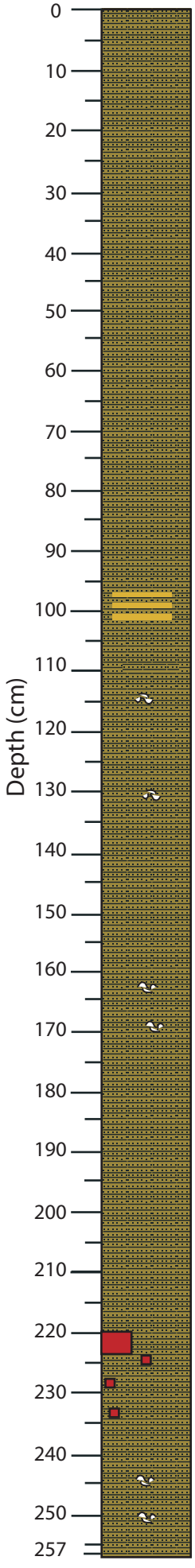
From 250 - 284 cm [Diatomaceous Clayey Silt], grayish olive (7.5Y 4/2),
heavy mottling (bioturbation) black (7.5Y 2/1)

From 286 - 346 [Diatomaceous Clayey Silt], grayish olive (7.5Y 4/2)
From 286 - 292 cm mottling grayish olive (7.5Y 4/3)
From 292 - 332 diatomaceous clayey silt homogeneous

From 332 - 346 soft sediment deformation as two recumbent and isoclinal folds.
The basal fold has parasitic folds. Both noted by the contrasting lithology
(v.f.s. and clayey silt)

From 346 - 402 cm [Diatomaceous Clayey Silt], grayish olive (7.5Y 4/2),
heavily mottled (bioturbation) black (7.5Y 2/1)





NT13-19-PC05- Sections 1, 2, 3

Latitude:
Core length: 353 cm
Date taken: 8/19/13
Date described: 8/22/13
Described by: McHugh

Longitude:
Water Depth:
Date opened: 8/22/13
Date photographed: 8/22/13
Flow-in: no

0-57 cm [Diatomaceous Clayey Silt], grayish olive (7.5Y 4/2)
0-2 cm soupy

57-257 [Diatomaceous Clayey Silt], olive black (7.5Y 3/2)

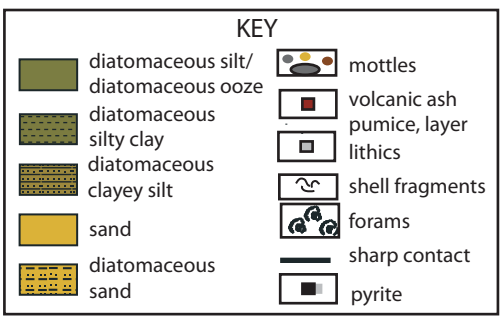
98 cm - 100 cm, three very fine sand lenses

Coarse silt lense at 110 cm

Shell fragments at: 111, 113, 122, 131-132, 146 cm

Shell fragments at: 164, 168, 241, 255 cm

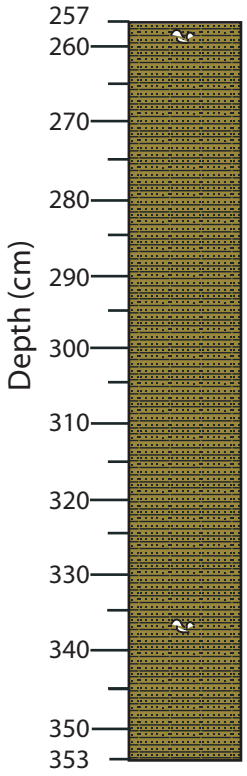
Ash pockets from 220 - 235 cm and bioturbation



NT13-19-PC05- Section 4

Latitude:
Core length: 353 cm
Date taken: 8/19/13
Date described: 8/22/13
Described by: McHugh

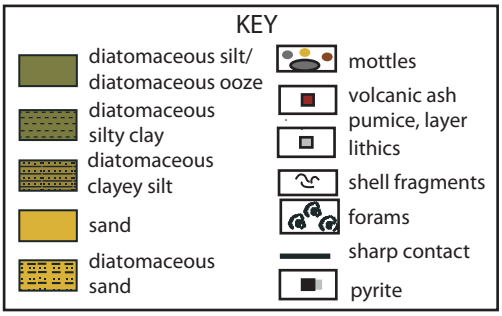
Longitude:
Water Depth:
Date opened: 8/22/13
Date photographed: 8/22/13
Flow-in: no



257 - 353 cm [Diatomaceous Clayey Silt], grayish olive (7.5Y 4/2)

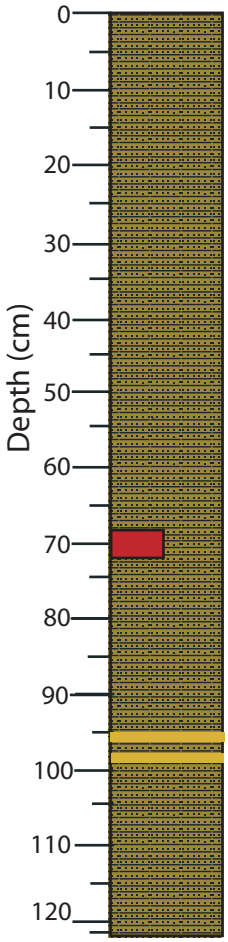
Mottling (bioturbation) throughout the section.

Shell fragments at: 259, 337 cm



NT13-19-PL05 Sections 01, 2, CC

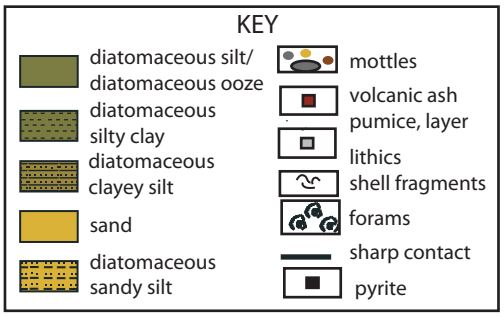
Latitude: Longitude:
Core length: 121 cm Water Depth:
Date taken: 8/1913 Date opened: 8 / 2 2 / 1 3
Date described: 8/22/13 Date photographed: 8 / 2 2 / 1 3
Described by: McHugh Flow-in: no



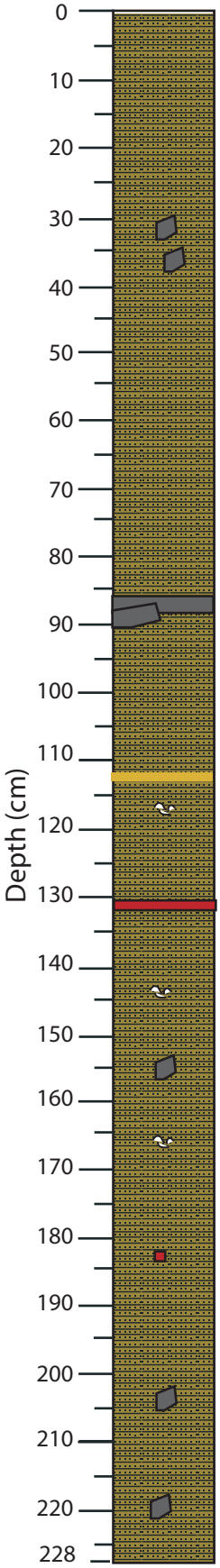
0-120 cm [Diatomaceous Clayey Silt], dark olive (7.5Y 4/3)

From 69 - 72 cm ash pockets, light gray (7.5Y 7/1)

At 96 and 97 cm very fine grained sand laminae



NT13-19-PC06- Sections 1, 2, 3



Latitude:
Core length: 524 cm
Date taken: 8//13
Date described: 8/23/13
Described by: McHugh

Longitude:
Water Depth:
Date opened: 8/20/13
Date photographe3: 8/23/13
Flow-in: no

0-228 cm [Diatomaceous Clayey Silt]

From 0 - 7 cm soupy, grayish olive (7.5Y 4/2)
From 7 to 228 cm, dark olive (7.5Y 4/3)
From 31 - 36 cm mottling, olive black (7.5Y 3/1)
From 36 to 86 the clayey silt is homogeneous with no mottling

From 86-91 cm mottling and color band with sharp base, black (10Y 2/1)

No mottling in between 91 - 113 cm, the clayey silt is homogeneous

At 113 cm very fine grained sand laminae

shell fragment at 117 cm

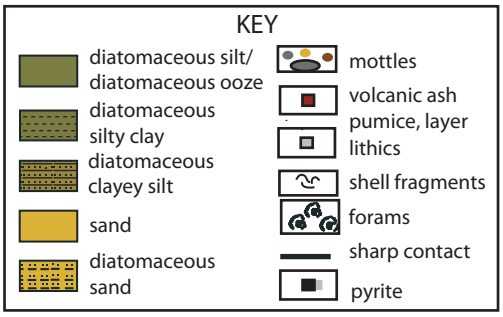
At 132 cm ash layer, light gray (7.5Y 7/1)
also very fine sand

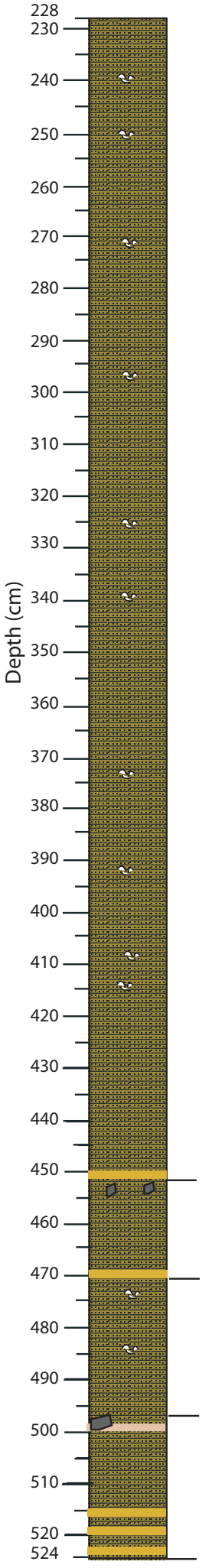
shell fragments at 142 cm, 167 cm

At 155-156 mottling, black (7.5Y 2/1)

possible ash pocket at 186-187 cm
Inside, gray (7.5Y 2/1) rim, black (7.5Y 2/1)

Scattered mottling at 206 cm, 220 cm





NT13-19-PC06- Sections 4, 5, 6

Latitude:
Core length: 524 cm
Date taken: 8//13
Date described: 8/23/13
Described by: McHugh

Longitude:
Water Depth:
Date opened: 8/20/13
Date photographe3: 8/23/13
Flow-in: no

228 - 524 cm [Diatomaceous Clayey Silt]

Shell fragments at 240, 251, 269-271, 298, 326 cm

Mottling throughout 228 - 328 cm ranging in color from dark olive (7.5Y 4/3) to olive black (7.5Y 3/2).

Shell fragments at 340, 373, 393, 408, 410-411 cm

Mottling throughout 328 - 451 cm from dark olive (7.5Y 4/3) to olive black (7.5Y 3/2)

KEY

- diatomaceous silt/ diatomaceous ooze
- diatomaceous silty clay
- diatomaceous clayey silt
- sand
- diatomaceous sand
- mottles
- volcanic ash
- pumice, layer
- lithics
- shell fragments
- forams
- sharp contact
- pyrite

At 451 cm very fine sand laminae, sharp basal contact

Mottling from 451 - 456 cm
From 456 - 470 cm homogeneous diatomaceous clayely silt, no mottling
At 470 cm very fine grained sand laminae

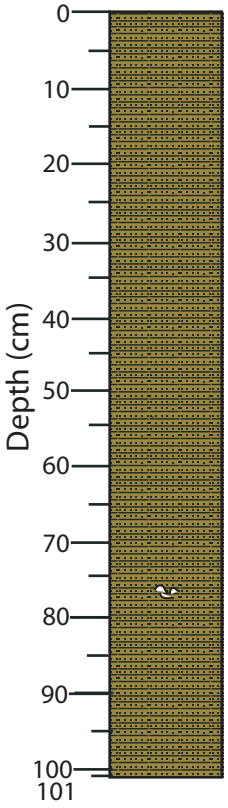
At 471, 483, 484 cm shell fragments

At 499 dark mottle, 500 - 501 light color band

From 501 - 515 cm homogeneous clayey silt, no mottling
At 515, 518, 522 very fine grained sand laminae

NT13-19-PL06 Sections 1, CC

Latitude: Longitude:
Core length: 101 cm Water Depth:
Date taken: 8/19/13 Date opened: 8/23/13
Date described: 8/23/13 Date photographed: 8/23/13
Described by: McHugh Flow-in: no



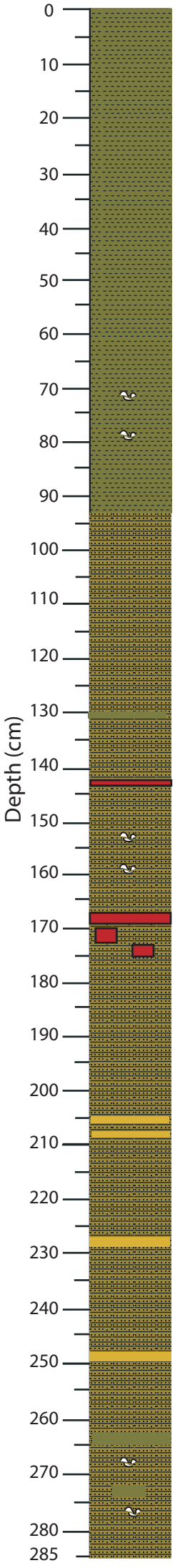
0-101 cm [Diatomaceous Clayey Silt], grayish olive (7.5Y 4/2)

Mottling throughout the sections

Shell fragments at 75 and 77 cm

KEY

- diatomaceous silt/ diatomaceous ooze
- diatomaceous silty clay
- diatomaceous clayey silt
- sand
- diatomaceous sandy silt
- mottles
- volcanic ash pumice, layer
- lithics
- shell fragments
- forams
- sharp contact
- pyrite



NT13-19-PC07- Sections 1, 2, 3

Latitude:
Longitude:
Core length: 285 cm
Water Depth:
Date taken: 8/20/13
Date opened: 8/24/13
Date described: 8/24/13
Date photographed: 8/24/13
Described by: McHugh
Flow-in: no

0- 92 cm [Diatomaceous Silty Clay], grayish olive (7.5Y 4/2)
0-12 cm soupy
Mottling (bioturbation) throughout the silty clay ranging in color from olive black (7.5Y 3/1) to grayish olive (7.5Y 5/3)

Shell fragments at 73 and 77 cm

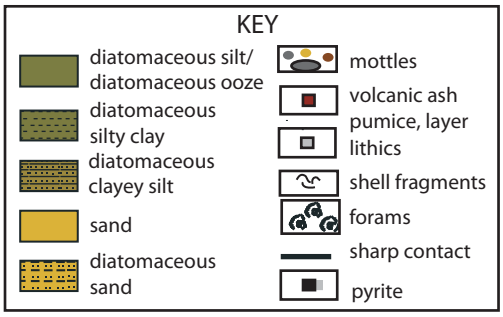
98 285 cm [Diatomaceous Clayey Silt], dark olive (7.5Y 4/3), from 220 - 285 cm more silt

132 cm coarse silt lamina

143 cm fine grained sand and ash lamina

Shell fragments at 153, 157- 162 cm

At 167 - 170 cm ash layer
Ash pockets at 170 - 172 cm and 172 - 175 cm



Very fine grained sand laminae 206, 208, 228 cm
From 208- 212 lighter color interval, grayish olive (7.5Y 4/2)

Very fine grained sand lamina 228 cm
228 - 231 cm lighter color interval, grayish olive (7.5Y 4/2)

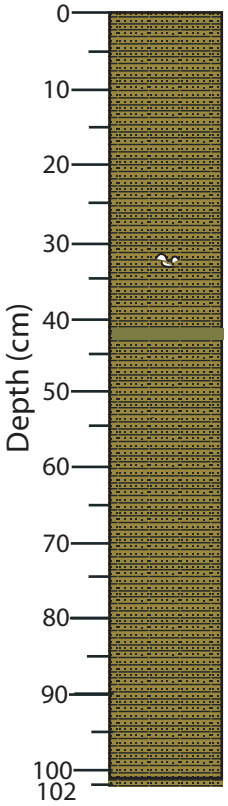
Very fine grained sand laminae 249 cm
249 - 253 cm lighter color interval, grayish olive (7.5Y 4/2)

Coarse silt laminae at 264 cm also scattered shells at this interval

Coarse silt lense 270 cm also scattered shells at this interval

NT13-19-PL07 Sections 1, CC

Latitude: Longitude:
Core length: 102 cm Water Depth:
Date taken: 8/20/13 Date opened: 8/24/13
Date described: 8/24/13 Date photographed: 8/24/13
Described by: McHugh Flow-in: no

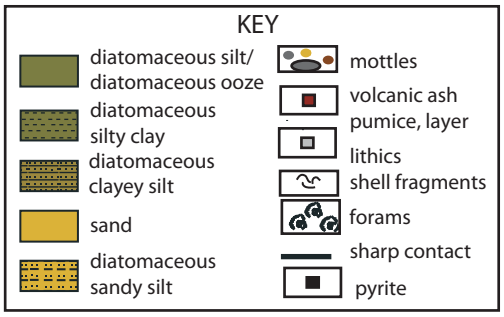


0-102 cm [Diatomaceous Clayey Silt],
grayish olive (7.5Y 4/2)

Mottling throughout the sections
Darker color mottling, olive black (7.5Y 3/1) at: 38, 39-41, 46-47 cm

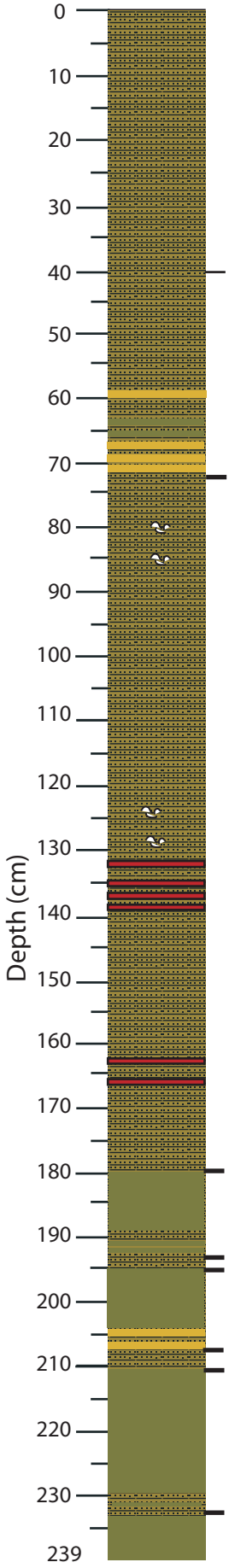
Shell fragments at 33 cm

Coarse silt lamina at 43 cm



NT13-19-PC08- Sections 1, 2, 3

Latitude: Longitude:
Core length: 534 cm Water Depth:
Date taken: 8/20/13 Date opened: 8/25/13
Date described: 8/25/13 Date photographed: 8/25/13
Described by: McHugh Flow-in: no



0 - 239 cm [Diatomaceous Silty Clay], grayish olive (7.5Y 4/2)
0-10 cm soupy

59 cm very fine grained sand laminae
65 - 67 cm silt laminae
69 - 71 cm fine grained sand laminae (contain ash?)
silt-sand interval is olive brown 7.5Y 3/1

Shell fragments at 81 and 83 cm

Shell fragments at 126 - 131 cm

133 - 139 cm four ash and sand laminae, brownish gray (7.5 YR 6/1)

164 - 167 cm two ash beds, fine sand, brownish gray (7.5 YR 6/1)

181 - 189 cm silt, dark olive (7.5Y 4/3)
189 - 191 cm silt laminae, sharp basal contact

191 - 196 cm homogeneous clayey silt, olive black, 7.5Y 3/1

196 - 204 cm silt, dark olive (7.5Y 4/3)
204 - 206 cm very fine grained sand laminae, sharp basal contact
206 - 211 cm clayey silt, mottling dark olive (7.5Y 4/3)

211 - 230 cm silt
230 - 232 cm coarse silt laminae, sharp basal contact

232 - 239 cm silt

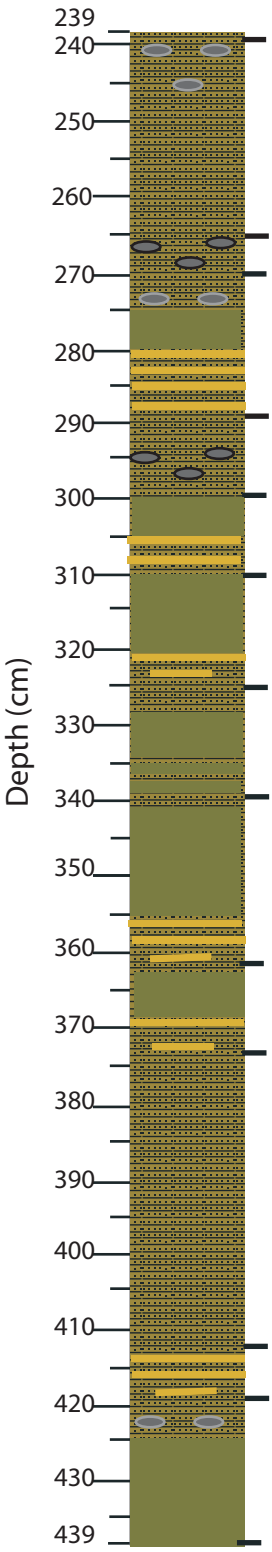
KEY

- diatomaceous silt/ diatomaceous ooze
- diatomaceous silty clay
- diatomaceous clayey silt
- sand
- diatomaceous sand
- mottles
- volcanic ash pumice, layer
- lithics
- shell fragments
- forams
- sharp contact
- pyrite

NT13-19-PC08- Sections 4, 5

Latitude:
Core length: 534 cm
Date taken: 8/20/13
Date described: 8/25/13
Described by: McHugh

Longitude:
Water Depth:
Date opened: 8/25/13
Date photographed: 8/25/13
Flow-in: no



239 - 439 cm [Diatomaceous Clayey Silt], grayish olive (7.5Y 4/2)

239 - 250 cm homogeneous clayey silt slight mottling (bioturbation)

266 - 269 mottling (bioturbation), olive black (7.5Y 3/1)

275 - 280 cm homogeneous silt, grayish olive (7.5Y 4/2)
280 - 289 cm very fine grained sand laminae, dark olive (7.5Y 4/3)

291-299 cm mottling (bioturbation) olive black (7.5Y 3/1)

299 - 306 cm homogeneous clayey silt, grayish olive (7.5Y 4/2)
306 - 308 cm very fine grained sand laminae, dark olive (7.5Y 4/3)
309 - 319 cm very silty, grayish olive (7.5Y 4/2)
322 - 323 cm very fine grained sand laminae and lense, dark olive (7.5Y 4/3)

329 - 334 cm very coarse silt, grayish olive (7.5Y 4/2)
334 - 339 cm coarse silt laminae, dark olive (7.5Y 4/3)

339 - 355 cm homogeneous diatomaceous silt, grayish olive (7.5Y 4/2)
355 - 361 cm very fine grained sand laminae and lenses, dark olive (7.5Y 4/3)

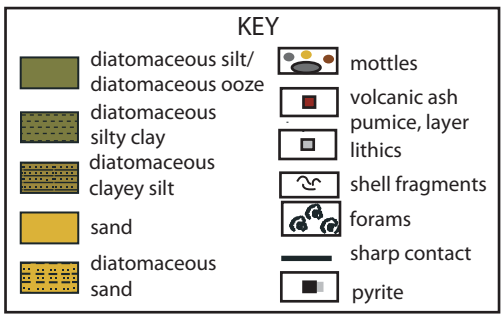
361 - 369 cm homogeneous diatomaceous silt, grayish olive (7.5Y 4/2)
371 - 372 cm very fine grained sand lamina and lense, dark olive (7.5Y 4/3)

372 - 413 cm homogeneous diatomaceous silt, no mottling, grayish olive (7.5Y 4/2)

414 - 419 cm very fine grained sand laminae and lenses, olive black (7.5Y 3/1)

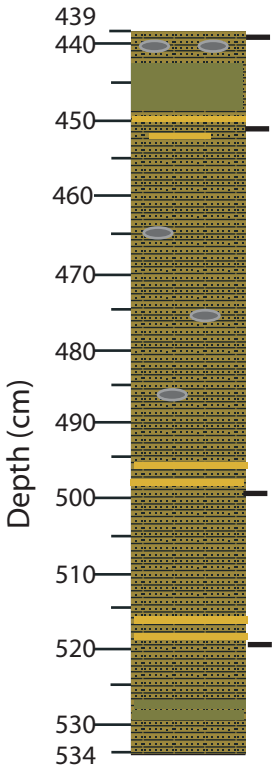
419 - 424 cm slight mottling (bioturbation), grayish olive (7.5Y 4/2)

424 - 439 cm homogeneous silt, dark olive (7.5Y 4/3)



NT13-19-PC08- Sections 6

Latitude:
Longitude:
Core length: 534 cm
Water Depth:
Date taken: 8/20/13
Date opened: 8/25/13
Date described: 8/25/13
Date photographed: 8/25/13
Described by: McHugh
Flow-in: no



439 - 534 cm [Diatomaceous Clayey Silt], grayish olive (7.5Y 4/2)

439 - 444 cm mottling, grayish olive (7.5Y 4/2)
444 - 449 cm, homogeneous clayey silt, dark olive (7.5Y 4/3)
449 - 453 cm, very fine grained sand lamina and lense, olive black (7.5Y 3/1)

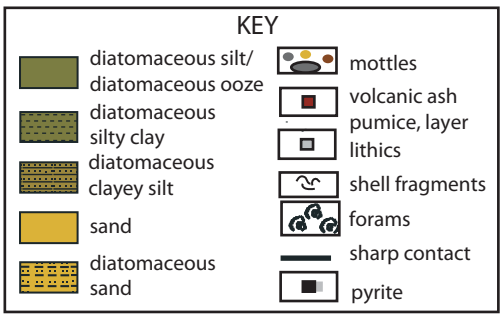
453 - 496 cm clayey silt, slight mottling, dark olive (7.5Y 4/3)

496 - 498 cm very fine grained sand laminae, olive black (7.5Y 3/1)

498 - 517 cm clayey silt, slight mottling, dark olive (7.5Y 4/3)

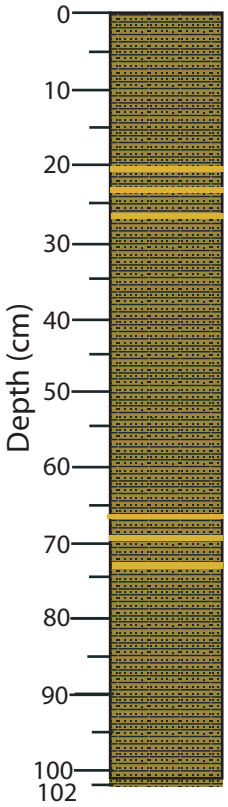
517 - 519 very fine grained sand laminae, olive black (7.5Y 3/1)

528 - 529 cm coarse silt laminae, olive black (7.5Y 3/1)



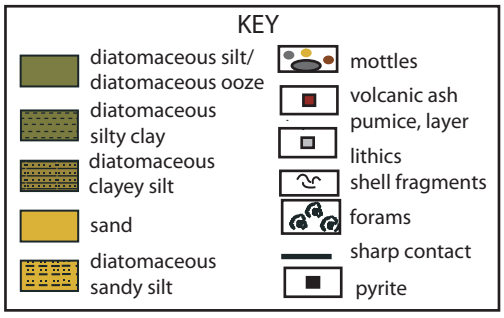
NT13-19-PL08 Sections 1, CC

Latitude: Longitude:
Core length: 102 cm Water Depth:
Date taken: 8/20/13 Date opened: 8 / 2 5 / 1 3
Date described: 8/25/13 Date photographed: 8 / 2 5 / 1 3
Described by: McHugh Flow-in: no



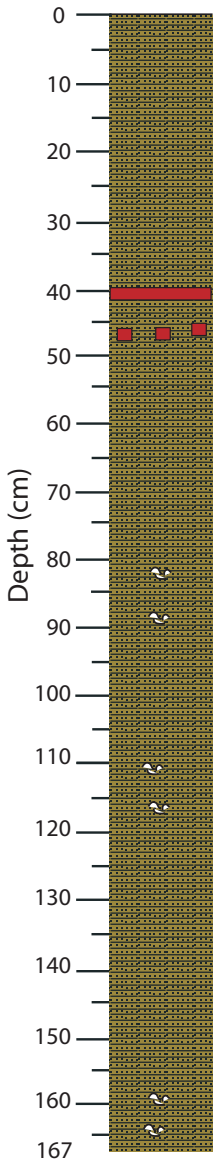
0-102 cm [Diatomaceous Clayey Silt], grayish olive (7.5Y 4/2)

Very fine grained sand laminae at 22 cm, 23 cm, 26 cm, 67-68 cm, 70 cm



NT13-19-PC09- Sections 1, 2

Latitude:
Longitude:
Core length: 358 cm
Water Depth:
Date taken: 8/21/13
Date opened: 8/26/13
Date described: 8/26/13
Date photographed: 8/26/13
Described by: McHugh
Flow-in: no



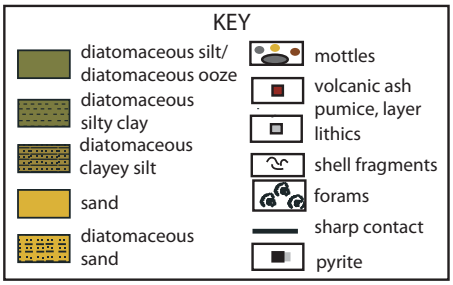
0 - 167 cm [Diatomaceous Clayey Silt]

Color banding:
0-20 cm grayish olive (7.5Y 4/2), 20-24 cm dark olive (7.5Y 4/3). This interval also contains mottling.
24-67 cm olive black (7.5Y 3/2)
39-42 cm ash layer, light brown (7.5YR 7/1)
47-49 cm ash pocket with bioturbation

From 67 to 167 cm [Diatomaceous Clayey Silt] contains color banding

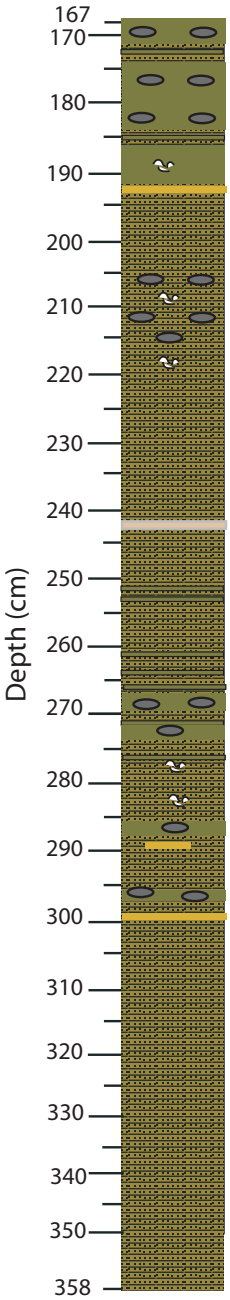
67-85 cm, olive black (7.5 Y 3/1)
85-91 cm, 94-104 cm, 109-115 cm, 121-124 cm, 124-127 cm, 129-132 cm, 144-149cm, 151-156 cm, 160-167 cm grayish olive (7.5Y 4/2)
91-94 cm, 104-109 cm, 115-118 cm, 121-124 cm, 127-129 cm, 132-144 cm, 149-151 cm, 157-160 cm dark olive (7.5Y 4/3)
156-157 cm grayish olive (7.5Y 5/2)

Shell fragments at 82, 88, 111-113, 162, 166 cm



NT13-19-PC09- Sections 3, 4

Latitude:
Longitude:
Core length: 358 cm
Water Depth:
Date taken: 8/21/13
Date opened: 8/26/13
Date described: 8/26/13
Date photographed: 8/26/13
Described by: McHugh
Flow-in: no



167 - 358 cm [Diatomaceous Clayey Silt]
Silt laminae at 173 cm silt interval 167-173 cm (dark olive 7.5Y 4/3) contains heavy mottling
Silt laminae at 185 cm, silt interval above 185 - 173 cm (dark olive 7.5Y 4/3) contains heavy mottling
Very fine grained sand lamina (olive black 7.5Y 3/1) at 193 cm, silt interval above 185 - 193 cm (dark olive 7.5Y 4/3)
Heavy mottling at 207 - 215 cm, dark olive (7.5Y 4/3)

Shell fragments 188, 209, 212

Light color band 242 - 243 cm, grayish olive (7.5Y 5/2)

262, 263, 264, 266 cm silt laminae

From 267 to 358 cm [Diatomaceous clayey silt]

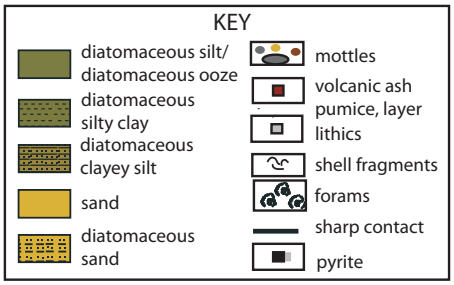
Silt laminae 267, 273, 276 cm

Shell fragments between 277 - 283 cm

Lenses of very fine grained sand at 288 cm

Sand laminae at 298 cm

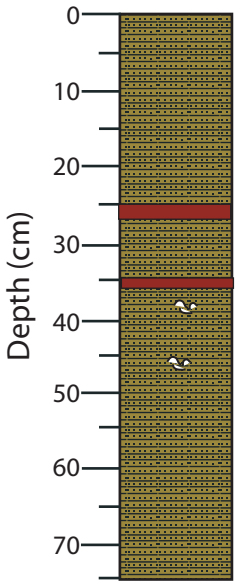
Silt rich intervals 267 - 269 cm, 272-273 cm, 275-276 cm, 286- 288 cm, 296 - 298 cm. These intervals are dark olive 7.5Y 4/3 and have mottling in them.
The rest of the sction is gray 7.5Y 3/1 with some mottling but less than in the silt-rich intervals.



NT13-19-PL09 Sections 1, CC

Latitude:
Core length: 75 cm
Date taken: 8/20/13
Date described: 8/26/13
Described by: McHugh

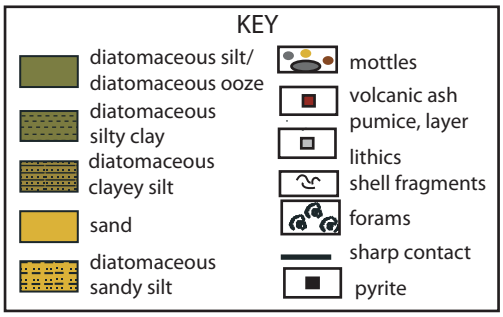
Longitude:
Water Depth:
Date opened: 8/26/13
Date photographed: 8/26/13
Flow-in: no

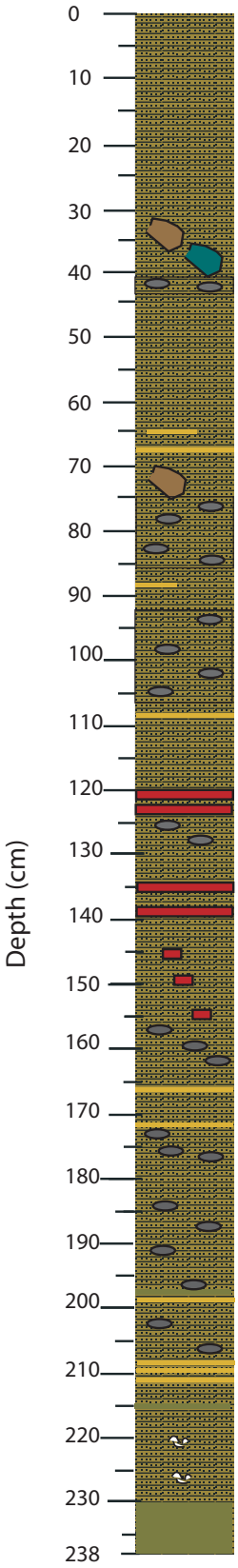


0 -75 cm [Diatomaceous Clayey Silt], grayish olive (7.5Y 4/2)
From 0-20 cm the clayey silt is dark olive 7.5Y 4/3
From 20 -30 cm it is grayish olive 7.5 Y 4/2

From 24 - 27 cm possible ash bed, also at 35 - 36 cm. Both layers contain fine grained sand and are gray 5Y 6/1

Shell fragments at 38 cm and 45 cm.
From 32- 75 cm it is olive black 7.5 Y 3/2





NT13-19-PC10- Sections 1, 2, 3

Latitude:	Longitude:
Core length: 536 cm	Water Depth:
Date taken: 8/21/13	Date opened: 8/27/13
Date described: 8/27/13	Date photographed: 8/27/13
Described by: McHugh	Flow-in: no

0-238 cm [Diatomaceous Clayey Silt], homogeneous, dark olive (7.5Y 4/3)

From 30 - 38 cm two sedimentary rocks. One possibly a diatomaceous mudstone, long axis 7 cm, olive black (7.5Y 3/2). The second is a conglomerate, 5 cm in diameter with a dark greenish gray matrix (5G 3/1) and angular clasts (1-3 cm in diameter), dark greenish gray 5G 4/1. Both rocks and clasts break easily with hand, so they are semi-indurated.

At 70 - 73 cm a third rock (possibly a diatomaceous mudstone) 3 cm in long diamter and olive black (7.5Y 3/2)

At 65- 67, 73, 88, 109 cm sand laminae and lenses, black 7.5Y 2/1

Mottling intervals 43 - 44, 73 - 88, 92-108, 123-128 cm, grayish olive 7.5Y 4/2

Ash layer 121 - 123 cm, 136 - 138 cm, gray 7.5Y 7/1

148 - 155 cm ash and sand pockets. Ash is light gray 7.5Y 7/1

Very fine grained sand laminae and lenses at: 167, 172, 198, 208, 209, 212 cm and coarse silt at: 198, 215 cm. Sand and silt laminae and lenses are black 7.5Y 2/3

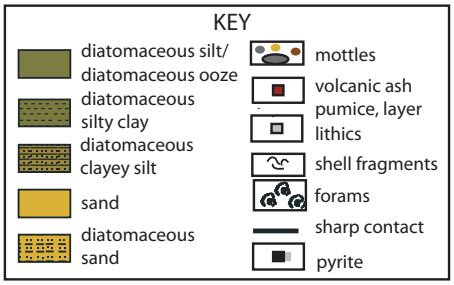
Mottling 158-162, 172-178, 186-194, 198- 208 cm

Clayey silt is olive black 7.5Y 3/2

Mottling is grayish olive 7.5Y4/2 and black 7.5Y2/3

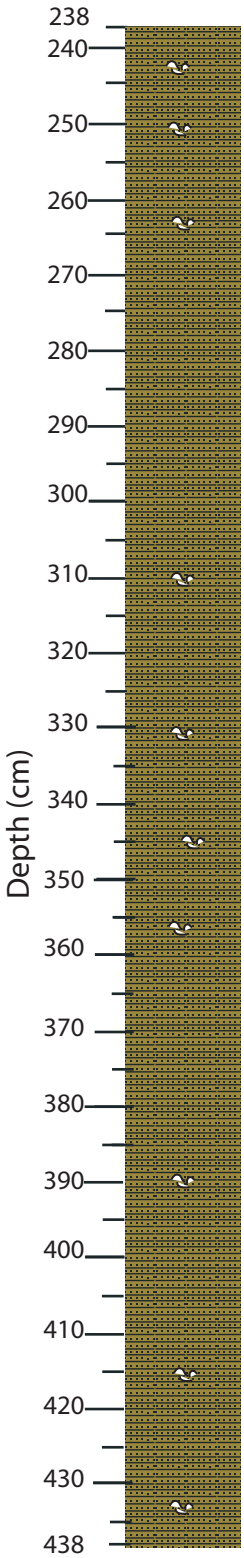
Shell fragments are pesent at 223, 226 cm

From 232 - 238 cm the sediment is silt



NT13-19-PC010- Sections 4, 5

Latitude:
Longitude:
Core length: 536 cm
Water Depth:
Date taken: 8/21/13
Date opened: 8/27/13
Date described: 8/27/13
Date photographed: 8/27/13
Described by: McHugh
Flow-in: no



238 - 438 cm [Diatomaceous Clayey Silt], homogeneous, dark olive (7.5Y 4/3)

Sand laminae and lenses at: 246, 247, 248, 241, 293, 294, 298, 303, 318, 318, 328

Silt laminae and lenses at: 242, 258, 265, 279, 333 cm

Sand and silt laminae and lenses are black 7.5Y2/1

Mottling intervals 242- 246, 252-254, 269-276, 279-293, 306-309, 318-326 cm
Mottling gryish olive 7.5Y 5/2

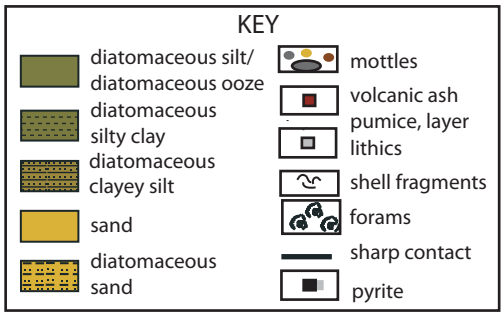
Shell fragments at 243, 250, 264, 311, 330, 334

Sand laminae and lenses at; 348, 354, 373, 377, 388, 395, 430-432, 435, 436

Silt laminae, lense at 408-409, 412, 422
Sand and silt laminae and lenses are black 7.5Y2/1

Mottling 338- 342, 361-368, 377-388, 388-395, 400-404, 415-422, 422-429
Mottling grayish olive 7.5Y 5/2

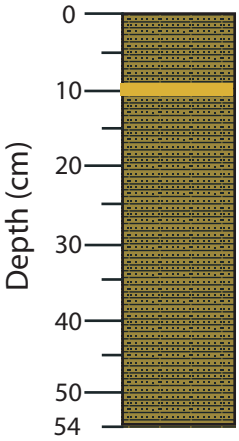
Shell fragments
356, 389, 416, 431 cm



NT13-19-PL10 Section 1

Latitude:
Core length: 54 cm
Date taken: 8/21/13
Date described: 8/27/13
Described by: McHugh

Longitude:
Water Depth:
Date opened: 8/27/13
Date photographed: 8/27/13
Flow-in: no

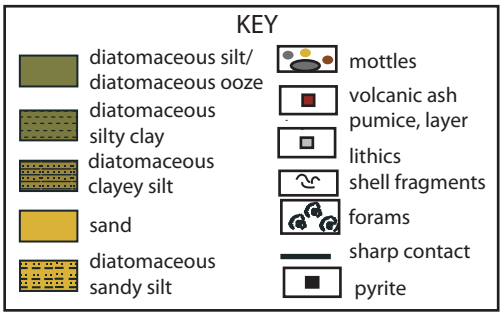


0 - 54 cm [Diatomaceous Clayey Silt], homogeneous dark olive 7.5Y4/3

0 - 2 cm soupy

Very fine grained sand lense 9-10 cm

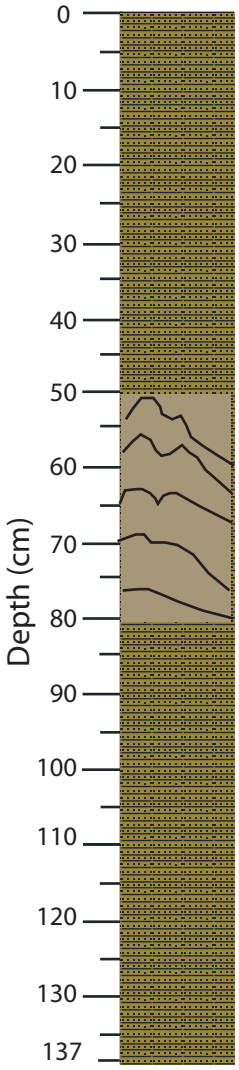
Color changes
0-10 cm, dark olive 7.5Y 4/3
10-27 cm, grayish olive 7.5Y 5/2
27-36 cm, dark olive 7.5Y 4/3
36-45 cm, grayish olive 7.5Y 5/2



NT13-19-PC011- Sections 1, 2

Latitude:
Core length: 334 cm
Date taken: 8/21/13
Date described: 8/26/13
Described by: McHugh

Longitude:
Water Depth:
Date opened: 8/26/13
Date photographed: 8/26/13
Flow-in: no

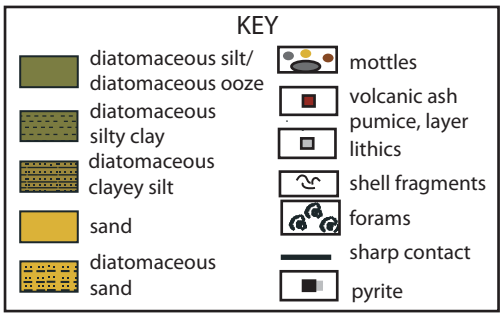


0 - 137 cm [Diatomaceous Clayey Silt], dark olive 7.5Y 4/3

From 0 - 87 cm homogeneous diatomaceous clayey silt, dark olive 7.5Y4/3

From 87 - 117 cm soft sediment deformation including folding and dipping beds noted by contrasting clayey silt and sand layers.

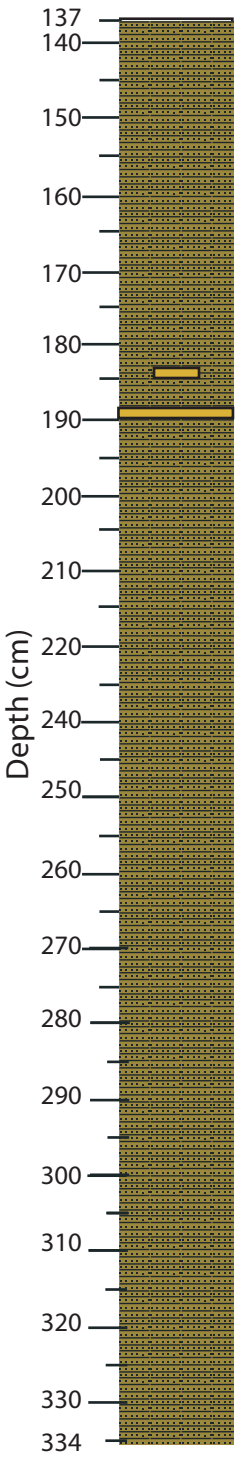
From 117 - 137 cm homogeneous clayey silt, dark olive 7.5Y 4/3



NT13-19-PC011- Sections 3, 4

Latitude:
Core length: 334 cm
Date taken: 8/21/13
Date described: 8/26/13
Described by: McHugh

Longitude:
Water Depth:
Date opened: 8/26/13
Date photographed: 8/26/13
Flow-in: no



137 - 175 cm [Diatomaceous Clayey Silt]

Color banding grayish olive 7.5Y 4/2 and dark olive 7.5Y 4/3. Bands are 2-5 cm thick

From 177 - 197 cm homogeneous clayey silt with sand lense at 185 cm. Sand is black 7.5Y 2/1

Also sand laminae at 188 cm

From 197 to 237 cm homogeneous clayey silt, olive black 7.5Y 3/1

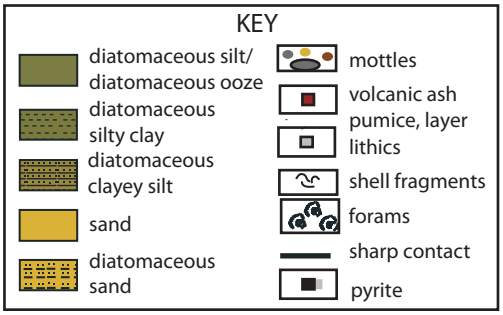
From 237 to 275 cm homogeneous diatomaceous clayey silt, olive black 7.5Y 3/2.

Color banded 2 cm thick, grayish olive7.5Y 4/2

From 279 - 325 cm 1 to 2 cm thick color bands, dark olive 7.5Y 4/3 and grayish olive 7.5Y 5/3

From 277 - 279 cm color bands are black 7.5Y 2/1 and olive black 7/5y 3/2

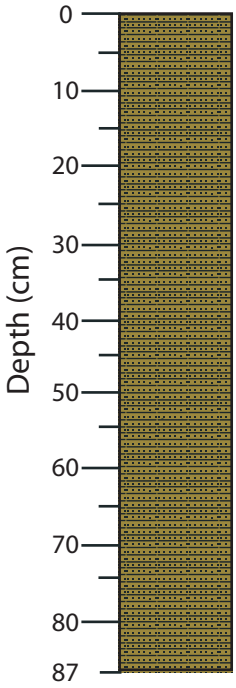
From 292 - 334 cm homogeneous silt olive black 7.5Y 3/2



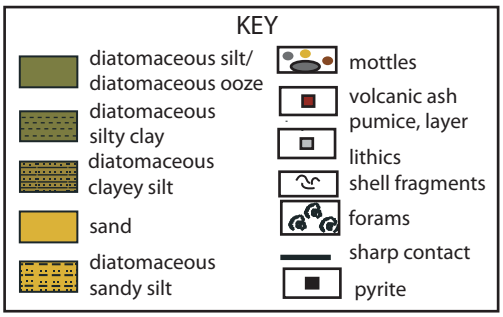
NT13-19-PL11 Sections 1

Latitude:
Core length: 86 cm
Date taken: 8/21/13
Date described: 8/26/13
Described by: McHugh

Longitude:
Water Depth:
Date opened: 8/26/13
Date photographed: 8/26/13
Flow-in: no

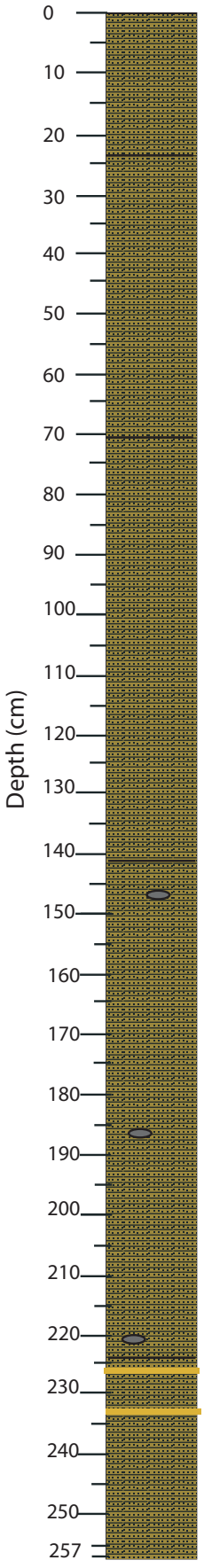


0 -86 cm [Diatomaceous Clayey Silt], grayish olive (7.5Y 4/2)
From 6 - 7 cm light color band (possible diatomo bloom?)



NT13-19-PC012- Sections 1, 2, 3

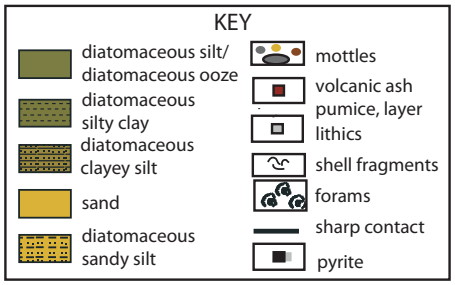
Latitude:
Longitude:
Core length: 552 cm
Water Depth:
Date taken: 8//13
Date opened: 9 / 2 / 1 3
Date described: 9/2/13
Date photographed: 9 / 2 / 1 3
Described by: McHugh
Flow-in: no



0-157 cm [Diatomaceous Clayey Silt], homogeneous, dark olive (7.5Y 4/3)
At 24 cm slight color variability from dark olive 4/3 to grayish olive 4/2

At 72 cm sharp contact, at 107 contact and color change to grayish olive 7.5Y 4/2
at 141 cm another slight color change to grayish olive 7.5Y 4/2
These color changes are subtle but marked by a sharp contact they may reflect slight lithological changes and/or water content.

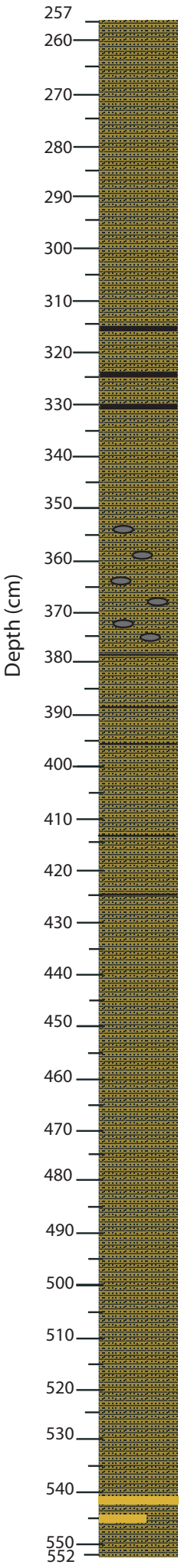
From 157 to 257 cm homogeneous clayey silt, olive black, very rare mottles black 7.5Y 2/1, they are mm in diamter and circular in shape. Some contain pyrite.



At 224 cm sharp contact,
beneath fine sand laminae,
From 234 to 257
no bioturbation, dark olive 7.5Y 4/3

NT13-19-PC012- Sections 4, 5, 6

Latitude: Longitude:
Core length: 552 cm Water Depth:
Date taken: 8/13 Date opened: 9/2/13
Date described: 9/2/13 Date photographed: 9/2/13
Described by: McHugh Flow-in: no



257 - 552 cm [Diatomaceous Clayey Silt], homogeneous, olive black (7.5Y 3/1)

Slight mottling, some mottles are circular black and possibly contain pyrite (< 1 cm in diamter)

Black laminae present at 317 cm, 324 cm, 333 cm.

333 cm to 357 cm homogeneous clayey silt, no mottling, olive black 7.5Y 3/2

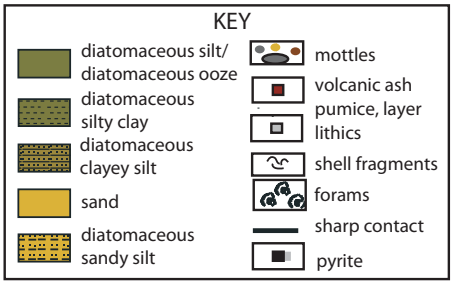
357 - 379 cm heavy mottling, black 7.5Y 2/1. Sharp contact at 379 cm

379 - 387 cm bray 7.5Y 4/1 with moderate mottling

387 - 396 cm grayish olvie 7.5Y 3/1, heavy mottling

396 - 457 cm homogeneous clayey silt. There are two sharp contacts marked by slight color changes to grayish olive 7.5 Y 4/2 from 396 to 414 cm,
to dark olive 7.5Y 4/3 from 414 to 425 cm, to olive black from 425 to 457 cm

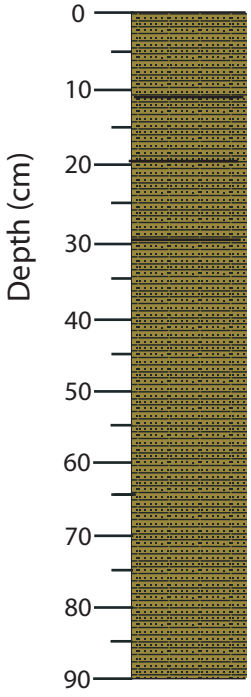
From 457 to 552 homogeneous clayey silt, olive black 7.5 Y 3/1



NT13-19-PL12 Section 1

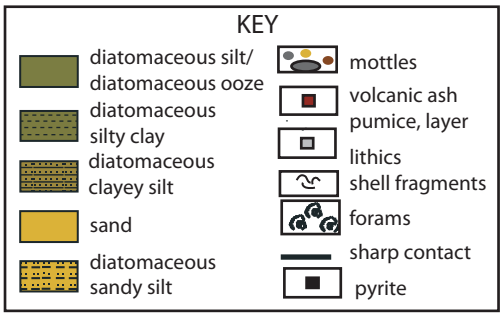
Latitude:
Core length: 90 cm
Date taken: 8//13
Date described: 9/2/13
Described by: McHugh

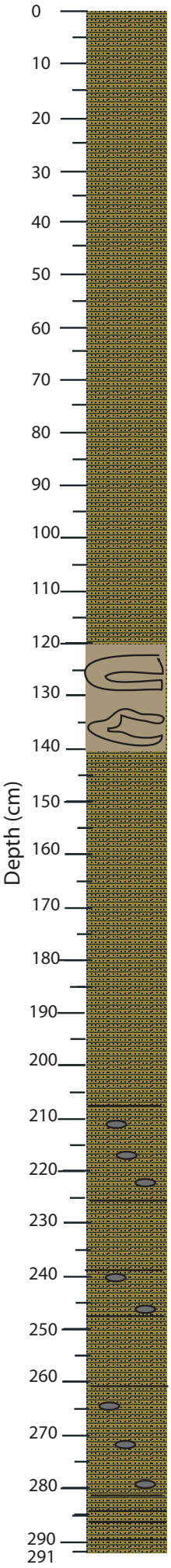
Longitude:
Water Depth:
Date opened: 9/2/13
Date photographed: 9/2/13
Flow-in: no



0 -90 cm [Diatomaceous Clayey Silt], dark olive 7.5Y 4/3

Homogeneous, slight color changes at 11, 20, 30 cm to lighter grayish olive 7.5 Y 5/3





NT13-19-PC013- Sections 1, 2, 3

Latitude:
Longitude:
Core length: 291 cm
Water Depth:
Date taken: 8/21/13
Date opened: 8/26/13
Date described: 8/26/13
Date photographed: 8/26/13
Described by: McHugh
Flow-in: no

0-291 cm [Diatomaceous Clayey Silt], homogeneous, grayish olive (7.5Y 4/2)
upper 10 cm soupy

121 - 141 cm soft sediment deformation: recumbent and isoclinar folds. Noted by slight color variability in the clayey silt

141 - 171 cm homogeneous clayey silt, olive black 7.5 3/2

171 - 184 cm evidence for fluid injection

187 - 191 cm the clayey silt is olive black, 7.5Y 3/1

191 - 208 cm homogeneous clayey silt, olive black (7.5Y 3/1), rare mottles, black

208 - 225 cm, heavy mottling, black 7.5Y 2/1

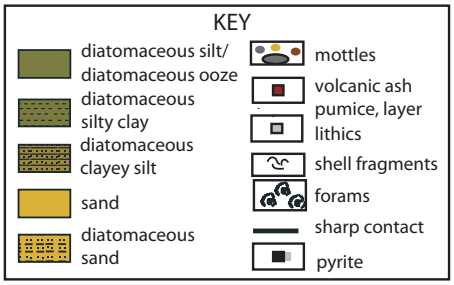
225 - 238 cm, homogeneous clayey silt, olive black (7.5Y 3/1), rare mottling

238 - 247 cm, heavy mottling, black 7.5Y 2/1

247 - 261 cm, homogeneous clayey silt, olive black (7.5Y 3/1), rare mottling

261 - 281 cm, heavy mottling, black 7.5Y 2/1

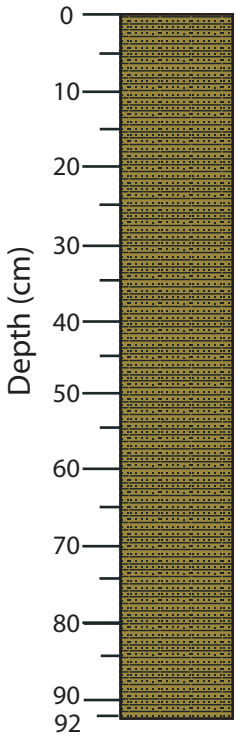
From 281 to 291 cm color banding black 7.5Y 2/1



NT13-19-PL13 Section 1

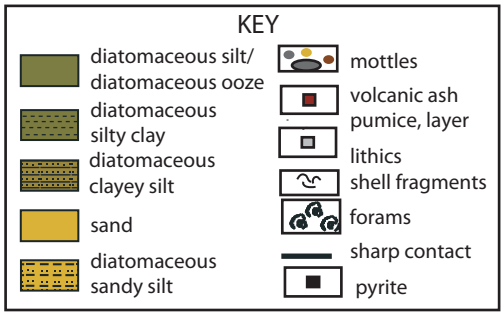
Latitude:
Core length: 92 cm
Date taken: 8/21/13
Date described: 8/26/13
Described by: McHugh

Longitude:
Water Depth:
Date opened: 8/26/13
Date photographed: 8/26/13
Flow-in: no



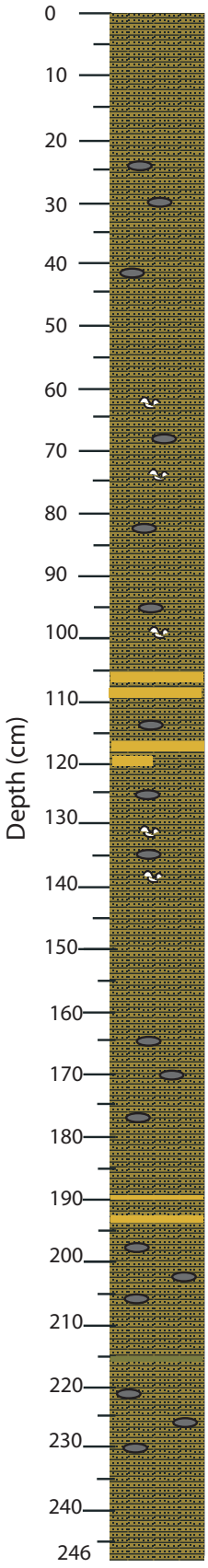
0 - 92 cm [Diatomaceous Clayey Silt], homogeneous dark olive 7.5Y4/3

0 - 2 cm soupy



NT13-19-PC14- Sections 1, 2, 3

Latitude:
Longitude:
Core length: 543 cm
Water Depth:
Date taken: 8//13
Date opened: 9 / 2 / 1 3
Date described: 9/2/13
Date photographed: 9 / 2 / 1 3
Described by: McHugh
Flow-in: no



0-246 cm [Diatomaceous Clayey Silt], dark olive (7.5Y 4/3)

This core is characterized by homogenous and bioturbated intervals and by also containing sand rich intervals. Most times a sand lamina is beneath the homogeneous sediment interval and above there is mottling and bioturbation.

46 - 87 cm it is a homogeneous and moderately bioturbated interval.
Color variability ranges from grayish olive 7.5Y 5/2 to dark olive 7.5Y 4/2 and olive black 7.5Y 3/1.
Fine sand is scattered in the upper 86 cm.
Five sand beds are present from 107 to 108 cm, black 7.5Y 2/1.

87-108 cm homogeneous clayey silt, dark olive 7.5Y 4/3

108 - 138 cm intervals of bioturbation, homogenous sediment and sand laminae and lenses. at 116 cm and 119 cm. Color variability: grayish olive 7.5Y 5/2, dark olive 7.5Y 4/2, olive black 7.5Y 3/1, slight bioturbation.

From 138 to 146 cm silt, homogeneous, dark olive 7.5Y 4/3.

146 - 164 cm homogeneous clayey silt
164 - 178 cm bioturbated

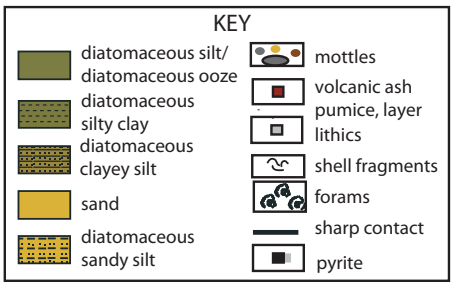
Shell fragments at 62, 76, 111, 134, 138 cm

178- 191 homogeneous, sand laminae black 2/1 at 191, 192 cm
194 - 206 cm bioturbation moderate

206 - 222 cm homogeneous, silt laminae at 216 cm

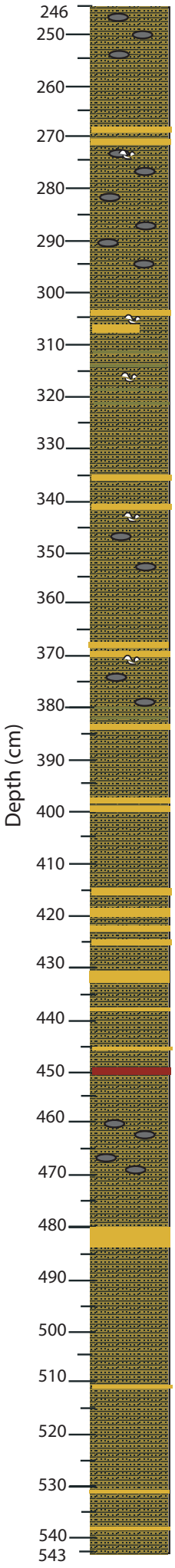
222 - 233 cm slight bioturbation

233 - 246 cm homogeneous



NT13-19-PC014 Sections 4, 5, 6

Latitude:
Longitude:
Core length: 543 cm
Water Depth:
Date taken: 8/13
Date opened: 9 / 2 / 1 3
Date described: 9/2/13
Date photographed: 9 / 2 / 1 3
Described by: McHugh
Flow-in: no



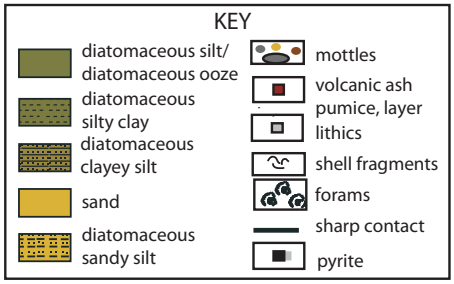
246 - 543 cm [Diatomaceous Clayey Silt]
These sections are characterized by homogenous and bioturbated intervals and by also containing sand rich intervals. Most times sand laminae are beneath the homogeneous sediment interval and above there is mottling and bioturbation. The sand is always fine grained and black 7.5Y2/1

246 - 256 cm slight mottling and bioturbation, olive black 7.5Y 3/1
256 - 270 cm, homogeneous dark olive 7.5Y 4/2, fine sand laminae at 270 and 271 cm
271 - 297 cm mottling bioturbation and homogeneous bands ~ 2 cm thick each,
dark olive 7.5Y 4/2, olive black 7.5Y 3/1, grayish olive 7.5Y 5/2
297 - 304 cm, homogeneous clayey silt, dark olive 7.5Y 4/2,
304 - 306 cm, sand laminae, lense and shell fragments at base.
306 - 336 cm, color banding homogeneous dark olive 7.5Y 4/2, silt laminae at 313, 319, 323 cm
336 - 346 homogeneous clayey silt, olive black 7.5Y 3/2. At 336 and 342 cm sand laminae
Shell fragments at 278 cm, 306 cm, 317 cm, 343 cm

346 - 410 cm clayey silt with intervals of homogeneous and bioturbated sediment with fine sand laminae generally at base of homogenous interval.
348 - 356 cm, mottling olive black 7.5Y 3/1, grayish olive 7.5Y 5/2
356 - 369 cm homogeneous clayey silt, olive black 7.5Y 3/2
369 -370 cm very fine grained sand laminae and shell fragments, sand black 7.5Y 2/1
370 - 382 cm mottling , olive black 7.5Y 3/1, grayish olive 7.5Y 5/2,
coarse silt laminae at 380 381, 382 cm
At 384 cm very fine grained sand laminae
382 - 399 cm, homogeneous clayey silt with very fine grained sand laminae at 398, 399 cm

403 - 410 cm homogeneous clayey silt, multiple sand beds and laminae from 414 to 446 cm.
Sand is fine grained and brown 5Y 4/2 (grayish olive). The clayey silt is grayish olive 5Y 4/2
Sand beds are present at 414-416 cm, 419 - 421 cm, 422 -423 cm, 424-425 cm, 431-434 cm
Sand laminae at 437 and 446 cm

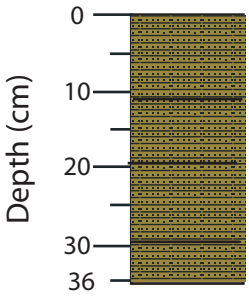
449 - 450 cm pink ash sand, brownish gray 7.5Y 5/1
453 - 463 cm homogeneous clayey silt, olive black 7.5Y 3/2
463 - 470 cm slight mottling bioturbation, olive black 7.5Y 3/1, grayish olive 7.5Y 5/2
blaxk sand lense at 469 cm
470 - 486 cm homogeneous clayey silt, olive black 7.5Y 3/1
480 - 484 black sand bed
490 - 496 cm mottling olive black 7.5Y 3/1, grayish olive 7.5Y 5/2
496 - 513 cm homogeneous clayey silt, olive black 7.5Y 3/1, black sand laminae at at 513 cm
517 - 531 cm homogeneous clayey silt
with black sand lamiane at 531 cm
531 - 539 homogeneous clayey silt, black sand laminae at 539 cm.



NT13-19-PL14Section 1

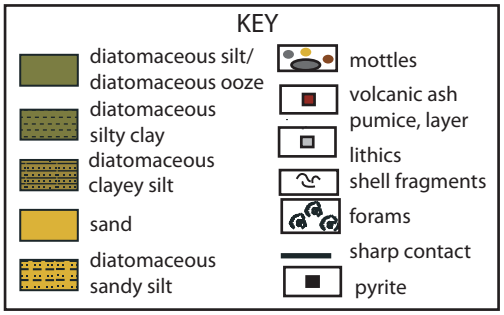
Latitude:
Core length: 36 cm
Date taken: 8//13
Date described: 9/2/13
Described by: McHugh

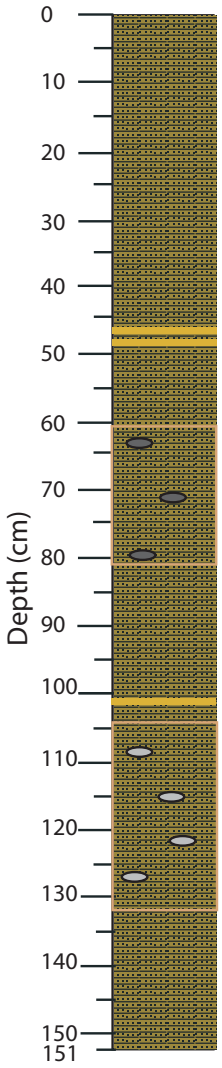
Longitude:
Water Depth:
Date opened: 9/2/13
Date photographed: 9/2/13
Flow-in: no



0 -36 cm [Diatomaceous Clayey Silt], dark olive 7.5Y 4/3

0-2 cm grayish olive 5Y 4/2 slight color banding at grayish olive 7.5Y5/3





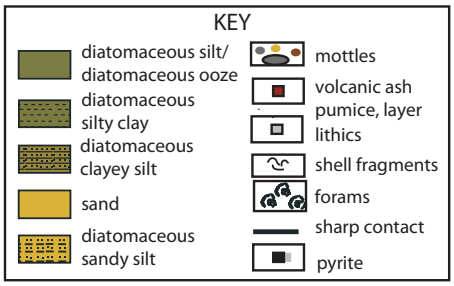
NT13-19-PC015- Sections 1, 2

Latitude:
Longitude:
Core length: 348 cm
Water Depth:
Date taken: 8/24/13
Date opened: 8/28/13
Date described: 8/28/13
Date photographed: 8/28/13
Described by: McHugh
Flow-in: no

0-151 cm [Diatomaceous Clayey Silt], homogeneous, dark olive (7.5Y 4/3)
upper 3 cm soupy
Two very fine grained sand laminae at 47-48 cm, 50 cm, 103 cm black 7.5Y 2/1

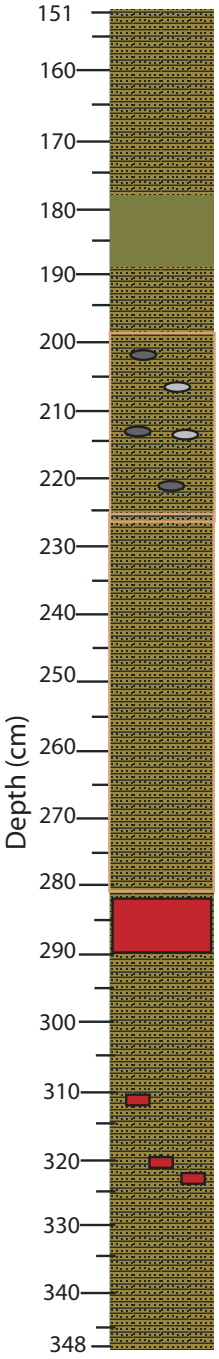
Intervals of mottling 61 - 81 cm, olive black 7.5Y 3/2

104 - 132 cm mottling grayish olive 7.5Y 4/2



NT13-19-PC015- Sections 3, 4

Latitude:	Longitude:
Core length: 348 cm	Water Depth:
Date taken: 8/24/13	Date opened: 8/28/13
Date described: 8/28/13	Date photographed: 8/28/13
Described by: McHugh	Flow-in: no



151 - 348 cm [Diatomaceous Clayey Silt], homogeneous, grayish olive (7.5Y 4/2)

Coarse silt laminae at 179 cm, 188 cm, black 7.5Y 2/1. In between a coarse silt interval

From 189 cm to 198 cm homogenous clayey silt, rare dark mottling

199 - 227 cm mottling grayish olive 7.5Y 4/2 and olive black 7.5Y 3/2

228 - 236 cm clayey silt gray 7.5Y 4/1 some mottling

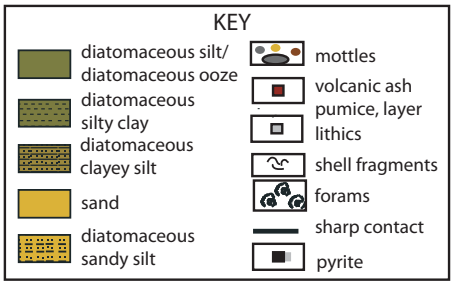
236 - 282 cm homogeneous grayish olive clayey silt 7.5Y 4/2 no mottling

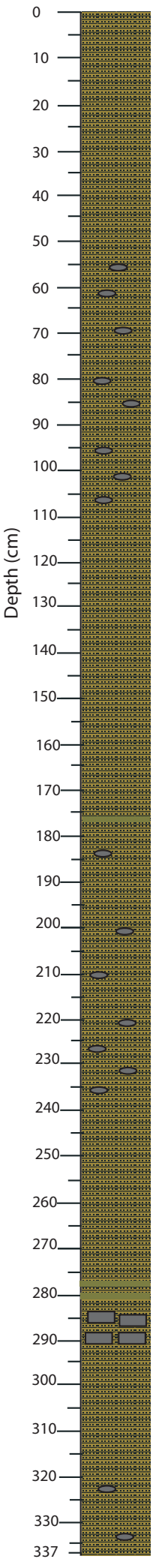
282 - 290 cm ash sand from 282 to 284 gray 7.5Y6/1 from 284 - 290 cm olive black 7.5Y 3/2

Ash sand laminae and pockets at 311, 320, 322 cm

From 290 - 319 cm clayey silt is olive black 7.5Y 3/2 with mottling black 7.5Y 2/1 and grayish olive 7.5Y 4/2

From 335 - 348 cm homogeneous dark olive 7.5Y 4/3 clayey silt





NT13-19-PC16- Sections 1, 2, 3, 4

Latitude:	Longitude:
Core length: 534 cm	Water Depth:
Date taken: 8//13	Date opened: 9 / 1 / 1 3
Date described: 8/30/13	Date photograph: 9 / 1 / 1 3
Described by: McHugh	Flow-in: no

0-347 cm [Diatomaceous Clayey Silt]
This core is characterized by intervals of homogeneous sediment and mottling and bioturbation. Bioturbation is noted as heavy, moderate, slight, and no bioturbation. Color varies in the core as a function of bioturbation ranging from black 7/5Y 2/1 for heavy bioturbation to moderate, olive black 7.5Y 3/1, to slight olive black 7.5Y 3/2 to no bioturbation dark olive 7.5Y 4/3

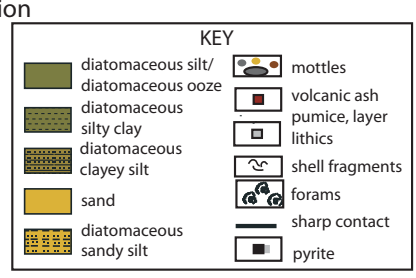
0-37 cm homogeneous, dark olive 7.5Y 4/3
37 - 55 no bioturbation, olive black 7.5Y 3/1
55 - 87 cm moderate bioturbation, olive black 7.5Y 3/2
87 - 95 cm no bioturbation, olive black 7.5Y 3/1
95 - 107 moderate bioturbation 7.5Y 3/1 olive black
107 - 137 cm no bioturbation, dark olive 7.5Y 4/3

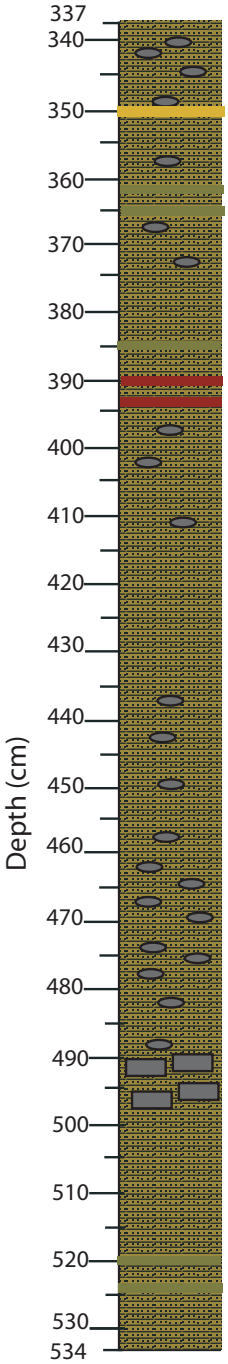
137 - 178
At 178 cm silt laminae, black 7.5Y 3/2, the sediment abov, 137 - 178 cm is homogeneours no bioturbation olive black 7.5Y 3/1
178 - 237 cm bioturbation from heavy at base to moderate to slight at the top. The color varies from black 7.5Y 2/1 to olive black 7.5Y 3/1 to dark olive 7.5Y 4/3
237 - 259 cm heavy bioturbation black 7.5Y 2/1

At 261 - 265 cm black laminae 7.5Y 2/1
278-281 cm coarse silt bed with basal scour contact. Blck 7.5Y 2/1

281 - 322 cm homogeneous clayey silt, no bioturbation. Olive balck 7.5Y 3/2

From 283 - 288 cm breccia - like soft sediment deformation
possible dewatering features
322- 337 cm slight bioturbation, olive black. 7.5Y 3/2





NT13-19-PC16- Sections 5, 6

Latitude: Longitude:
Core length: 534 cm Water Depth:
Date taken: 8//13 Date opened: 9 / 1 / 1 3
Date described: 8/30/13 Date photograph: 9 / 1 / 1 3
Described by: McHugh Flow-in: no

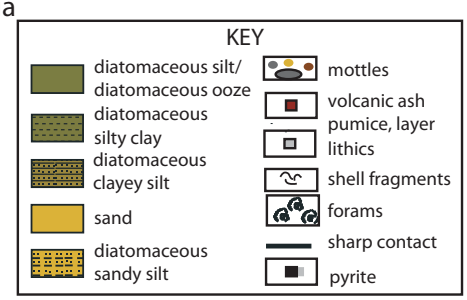
347- 534 cm [Diatomaceous Clayey Silt]
This core is characterized by intervals of homogeneous sediment and mottling and bioturbation. Bioturbation is noted as heavy, moderate, slight, and no bioturbation. Color varies in the core as a function of bioturbation ranging from black 7/5Y 2/1 for heavy bioturbation to moderate, olive black 7.5Y 3/1, to slight olive black 7.5Y 3/2 to no bioturbation dark olive 7.5Y 4/3

337 - 350 cm moderate bioturbation, oliveblack 7.5Y 3/2.
Fine grained sand laminae at 350 cm

350 - 378 cm slight bioturbation, olive black 7.5 Y 3/2
At 374 cm a shell fragment
362 - 378 cm possibly fine silt laminae
362 - 363 cm silt ash laminae,
367 - 385 cm ~ 2 cm each black bands
384- 385 cm ash silt bed?
390 - 394 cm ash sand bed, ligth gray 10 YR 7/1
395 - 417 cm slight bioturbation, olive black 7.5Y 3/2
417 - 437 no bioturbation, grayish olive 7.5Y 4/2
437 - 461 cm slight bioturbation, olive black 7.5Y 7.5Y 3/2
461- 478 cm heavy bioturbation, olive black, 7.5 Y 3/1
478 - 486 cm slight bioturbation, olive black 7.5Y 3/2

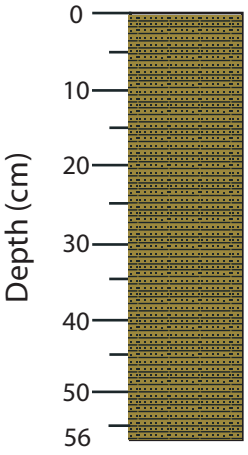
492 - 497 cm the clayey silt looks like breccia (possible dewatering features)
486 - 524 cm no bioturbation

486 - 520 cm olive black 7.5Y 3/2
520 - 524 coarse silt laminae,
dark olive 7.5Y 4/3

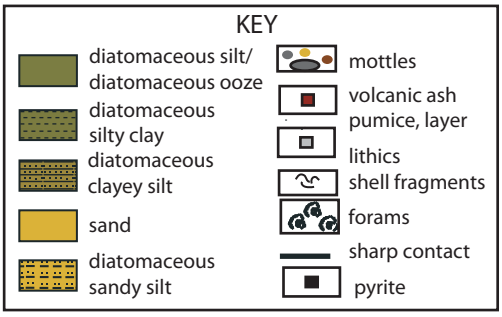


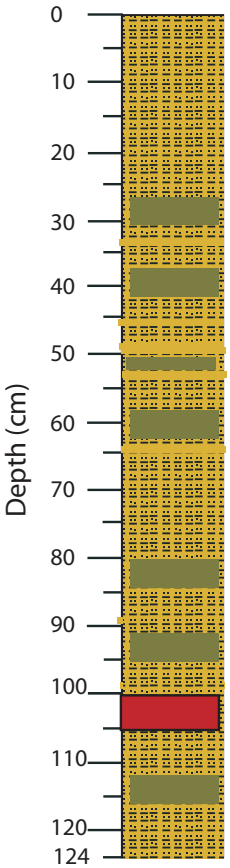
NT13-19-PL16 Section 1, CC

Latitude: Longitude:
Core length: 56 cm Water Depth:
Date taken: 8//13 Date opened: 9 / 1 / 1 3
Date described: 9/1 Date photographed: 9 / 1 / 1 3
Described by: McHugh Flow-in: no



0 - 56 cm [Diatomaceous Clayey Silt], dark olive 7.5Y 4/3





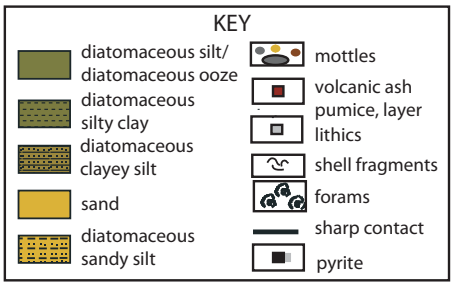
NT13-19-PC017- Sections 1, 2

Latitude:
Longitude:
Core length: 323 cm
Water Depth:
Date taken: 8/24/13
Date opened: 8/28/13
Date described: 8/28/13
Date photographed: 8/28/13
Described by: McHugh
Flow-in: no

0-124 cm [Diatomaceous Sandy Silt], homogeneous, grayish olive (7.5Y 4/2)
Very fine grained sand scattered throughout the section but also as laminae and lenses at:
29-30, 42-45, 47, 48, 49, , 60, 85, 94 cm.
Sand is black 7.5Y 2/1

Dark color intervals (olive black 7.5Y 3/2) at 28-31 cm, 40-43, 48-54, 64-71, 80-84, 91-94, 112-124cm

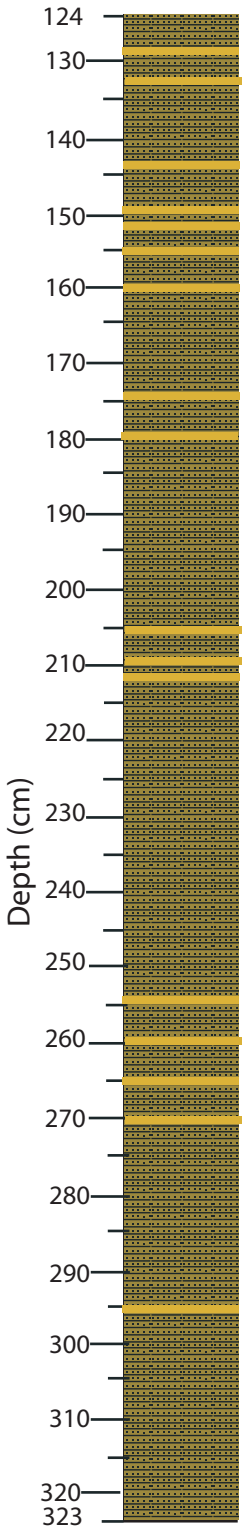
Ash sand from 102-108 cm, gray 7.5Y 6/1



NT13-19-PC017- Sections 3, 4

Latitude:
Core length: 323 cm
Date taken: 8/24/13
Date described: 8/28/13
Described by: McHugh

Longitude:
Water Depth:
Date opened: 8/28/13
Date photographed: 8/28/13
Flow-in: no



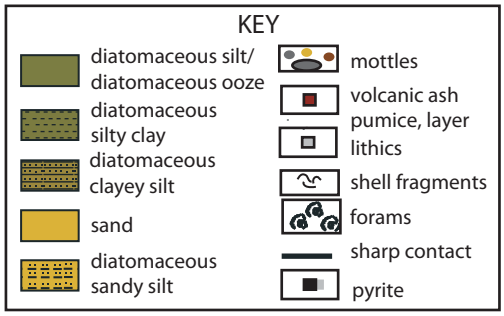
124 - 224 cm [Diatomaceous Clayey Silt], homogeneous, dark olive (7.5Y 4/3)

Very fine grained sand is present at 129, 132, 144, 148, 150, 154, 160, 175, 178, 206, 209, 210, 211 cm. Sand is black 7.5Y 2/1

There are also dark color intervals above the sand, olive black 7.5Y 3/1 at: 136-140, 152-161, 174-179, 184-194, 204-224 cm

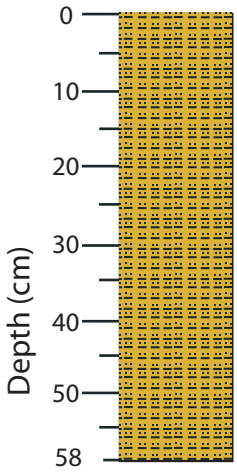
Very fine grained sand is present at 255, 260, 265, 267, 270, 271, 296, 297 cm. Sand is black 7.5Y 2/1

Color banding and mottling black 7.5Y 2/1
There are also light color bands gray 7.5Y 4/1



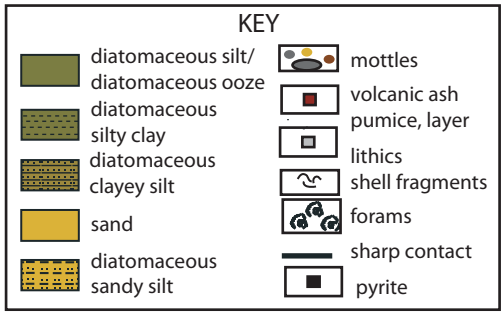
NT13-19-PL17 Section 1

Latitude: Longitude:
Core length: 58 cm Water Depth:
Date taken: 8/21/13 Date opened: 8 / 2 8 / 1 3
Date described: 8/28/13 Date photographed: 8 / 2 8 / 1 3
Described by: McHugh Flow-in: no



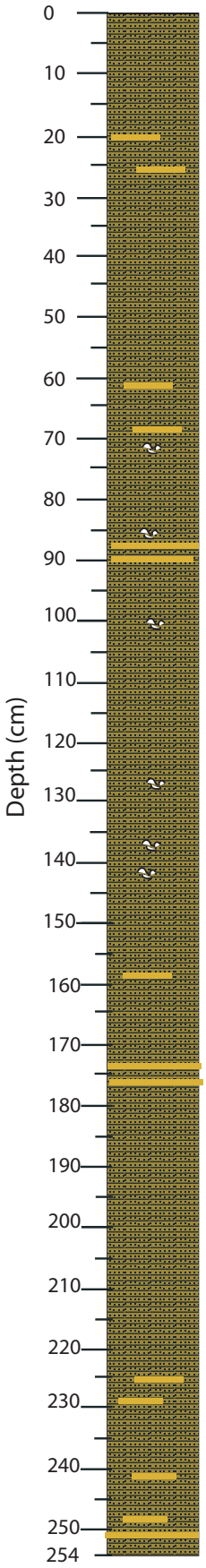
0 - 58 cm [Diatomaceous Sandy Silt], homogeneous dark olive 7.5Y4/3

Very fine grained sand is scattered throughout the section but can also be found as laminae and lenses at 6, 7, 11, 23, 26, 29, 36, 40. 47, 48, 56, 57 cm.



NT13-19-PC018- Sections 1, 2, 3

Latitude:
Longitude:
Core length: 554 cm
Water Depth:
Date taken: 8//13
Date opened: 8 / 3 1 / 1 3
Date described: 8/31/13
Date photographed: 8 / 3 1 / 1 3
Described by: McHugh
Flow-in: no



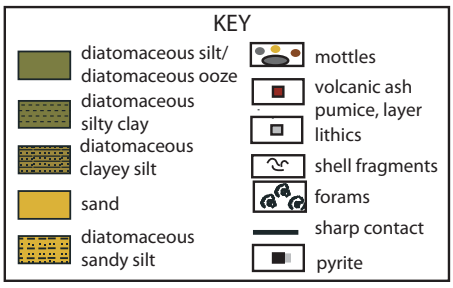
0-254 cm [Diatomaceous Claey Silt]

Color banding dark olive (7.5Y 4/3) and grayish olive (7.5Y 4/2)
Sand black 7.5Y 2/1
Sand lense 20, 26 cm, 62, 69, 158

Shell fragments at: 73, 86, 102, 129, 140, 144 cm

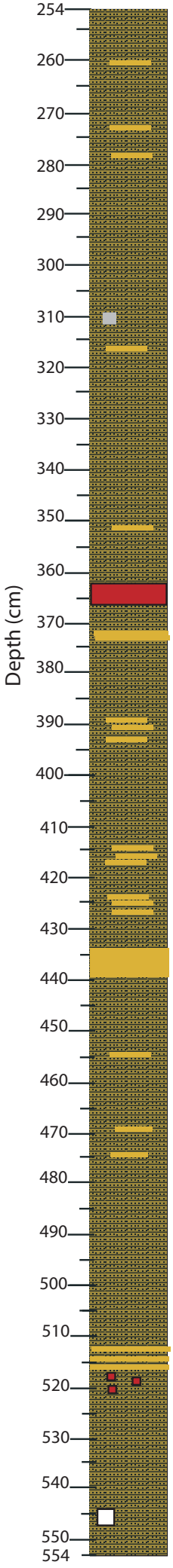
Sand bed 87 - 88 cm

Sand bed and laminae at: 174-175, 226, 229 , 243, 244 250, 253 cm



NT13-19-PC018- Sections 4, 5, 6

Latitude: Longitude:
Core length: 554 cm Water Depth:
Date taken: 8//13 Date opened: 8 / 3 1 / 1 3
Date described: 8/31/13 Date photographed: 8 / 3 1 / 1 3
Described by: McHugh Flow-in: no



254 - 554 cm [Diatomaceous Claey Silt]

Color banding dark olive (7.5Y 4/3) and grayish olive (7.5Y 4/2)

Rare sand lense and laminae: 260, 274, 278, 317 and 352 cm

312- 313 cm igenous intermediate rock, well rounded, smooth, 4 cm long diameter

Ash sand, 363 -367 cm, gray 7.5Y 5/1, has quartz, hornblende, opx, cpx
372 - 373 cm sand bed, black 7.5Y 2/1

Sand lenses at 391 - 393 (has forams),

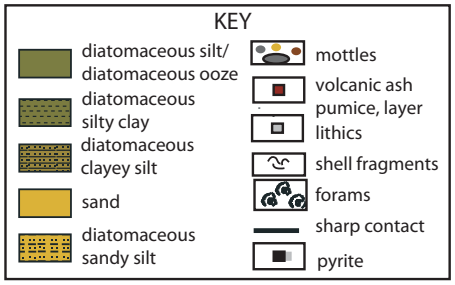
Sand lenses at 417 - 419 , 425 - 427 cm both with "v" shaped scour bases , sand is black 7.5Y 2/1

434- 439 sand bed contains quartz, opx, cpx, hornblende, glauconite (detrital), has forams. The bed has a sharp lower contact and fines upwards

Sand lenses with sharp basal contacts at 456 cm, 471, 474 cm

Sand laminae at 514, 515, 516, 517, 519 cm, black 7.5Y 2/1

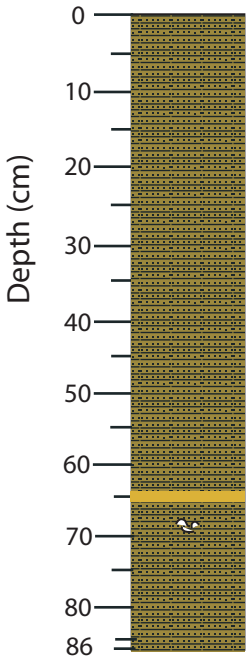
Ash pockets from 518 - 519 cm, gray 7.5Y 5/1



546 cm quartz rich sandstone with opx and cpx minerals. It is 2 cm long

NT13-19-PL18 Section 1, CC

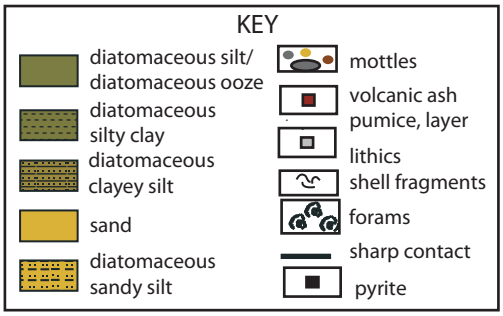
Latitude: Longitude:
Core length: 86 cm Water Depth:
Date taken: 8//13 Date opened: 8/31/13
Date described: 8/31/13 Date photographed: 8/31/13
Described by: McHugh Flow-in: no



0 - 86 cm [Diatomaceous Clayey Silt]

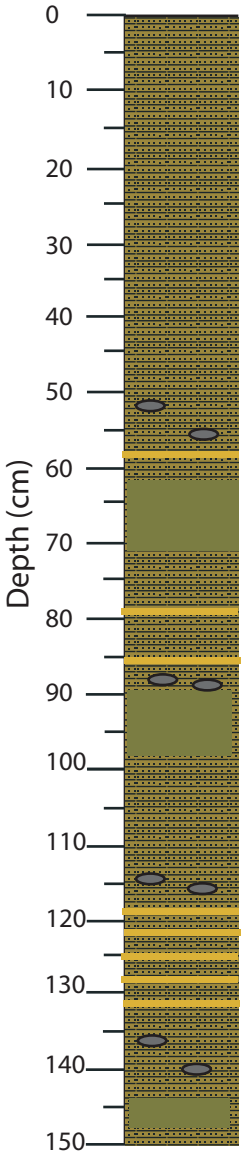
Color banding dark olive 7.5Y 4/3 and grayish olive 7.5Y 4/2

Sand laminae at 65 cm, shell fragments 67 and 72 cm



NT13-19-PC019- Sections 1, 2

Latitude:
Longitude:
Core length: 348 cm
Water Depth:
Date taken: 8/24/13
Date opened: 8/28/13
Date described: 8/28/13
Date photographed: 8/28/13
Described by: McHugh
Flow-in: no

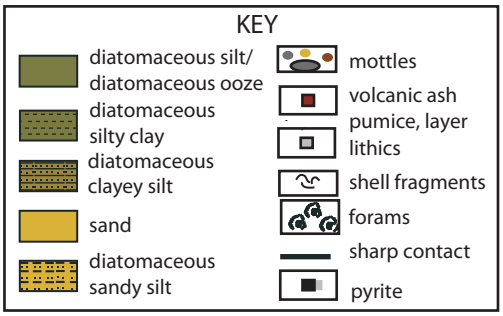


0-150 cm [Diatomaceous Sandy Silt], homogeneous, grayish olive (7.5Y 4/2)
Very fine grained sand laminae and lenses at: 59, 78, 86, 118-131 cm (six laminae)
Sand is black 7.5Y 2/1

Coarse silt laminae towards base of core 143 - 150 cm

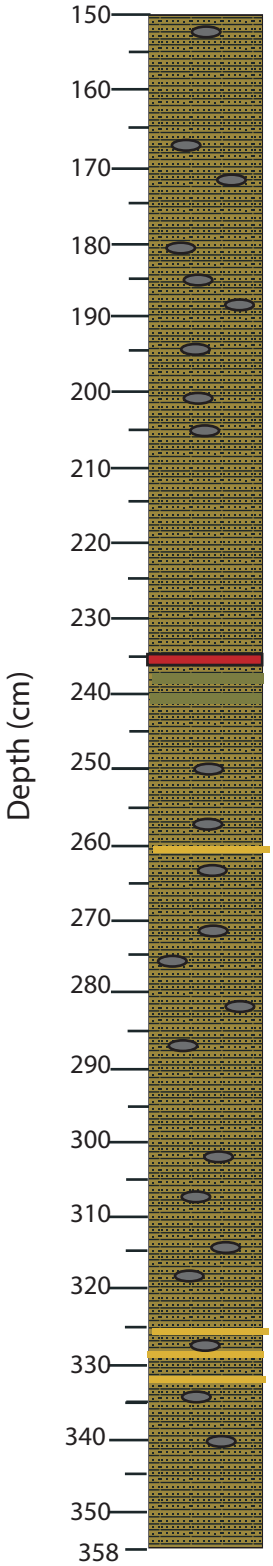
Sand and silt have above homogeneous clayey silt: 60- 71 cm, 90 - 99 cm, 120 - 135cm, dark olive 7.5Y 4/3

Mottling intervals (olive black 7.5Y 3/1)
above homogeneous sediment
at 50- 58 cm, 86-90 cm, 115-120 cm, 137-142 cm



NT13-19-PC019- Sections 3, 4

Latitude:
Longitude:
Core length: 348 cm
Water Depth:
Date taken: 8/24/13
Date opened: 8/28/13
Date described: 8/28/13
Date photographed: 8/28/13
Described by: McHugh
Flow-in: no



150 -348 cm [Diatomaceous Sandy Silt], homogeneous, grayish olive (7.5Y 4/2)
Rare very fine grained sand laminae and lenses at: 202 cm, 206 cm

Coarse silt interval at 237 - 240 cm

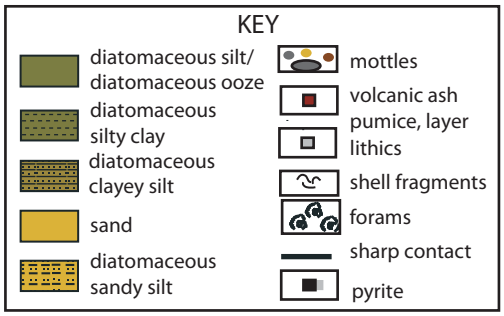
Ash sand layer 241 - 248 cm

Heavy mottling intervals (black 7.5Y 3/1) at: 151-153 cm, 168 - 172 cm, 180 - 187 cm, 190 - 195 cm, 200 - 206 cm

Very fine grained sand and coarse silt laminae at:
262 cm, 328 cm, 332 cm

Color variability: dark intervals (black 7.5Y 3/1) at: 252- 260 cm,
303-313 cm, 328 - 333 cm, and laminae 262 cm, 272 cm, 275 cm, 283 cm, 286 cm, 287 cm, 303 cm, 317 cm, 339 cm

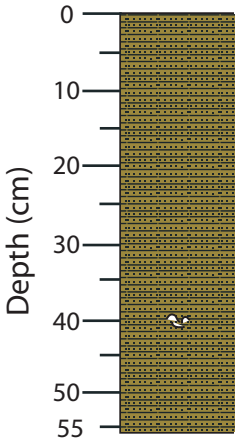
Sand at 327 cm, 328 cm, black 7.5Y 2/1



NT13-19-PL19 Section 1

Latitude:
Core length: 55 cm
Date taken: 8/21/13
Date described: 8/28/13
Described by: McHugh

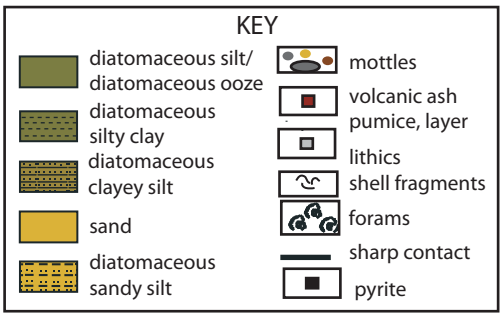
Longitude:
Water Depth:
Date opened: 8/28/13
Date photographed: 8/28/13
Flow-in: no



0 - 55 cm [Diatomaceous Clayey Silt], homogeneous olive black 7.5Y 3/2

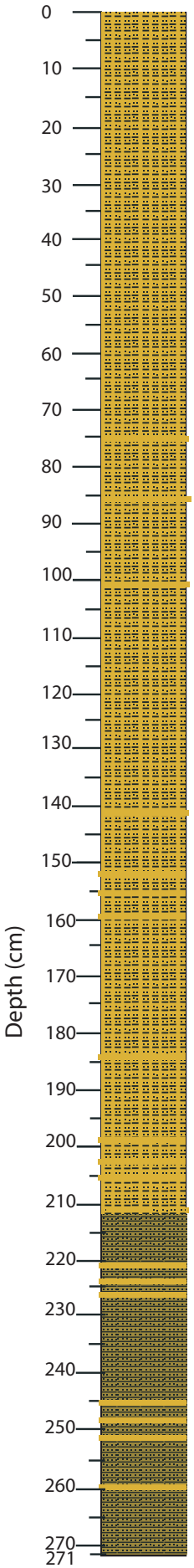
Color bands black 7.5Y 2/1 at 39, 41, 42 cm

Shell fragments 42-43 cm



NT13-19-PC020- Sections 1, 2, 3

Latitude:
Longitude:
Core length: 471 cm
Water Depth:
Date taken: 8//13
Date opened: 8/30/13
Date described: 8/30/13
Date photographed: 8/30/13
Described by: McHugh
Flow-in: no



0-211 cm [Diatomaceous Sandy Silt], homogeneous, grayish olive (7.5Y 4/2) and olive black 7.5Y 3/1

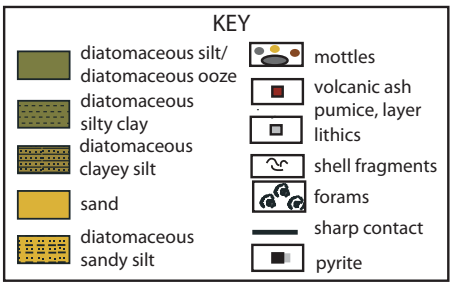
PC20 is characterized by very thin (< 3 cm) to thin (> 3 cm - 10 cm) beds of sandy silt and clayey silt, and fine to coarse sand laminae and lenses
The beds, laminae and lenses have sharp basal contacts.
The upper contacts are sharp, scoured (angular or wavy) and rarely gradational with bioturbation.
Beds have color variability ranging from grayish olive (7.5Y 4/2) to grayish olive (7.5Y 5/2) to olive black (7.5Y 3/1).
Shell fragments are incorporated in the sand laminae and lenses.

Sand laminae are present at: 76, 86, 101, 119, 141, 153, 155, 158 cm

171 - 211 cm [Diatomaceous Sandy Silt]
Color: grayish olive 7.5Y 4/2, olive black 7.5Y 3/1, sand black 7.5Y 2/1

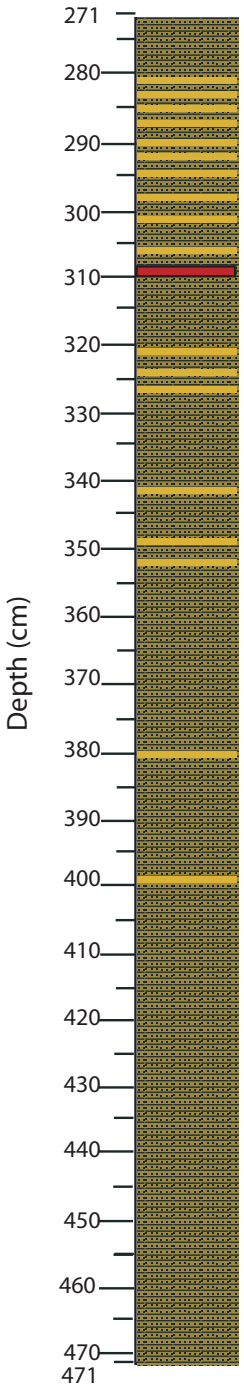
Coarse sand laminae and bed 194 - 211 cm: 194, 198, 199, 200, 201, 202, 203, 204, 205, 211 cm

211 - 271 cm [Diatomaceous Clayey Silt]
Sand laminae at: 221-226 cm, 246, 249, 253, 259, 260



NT13-19-PC020- Sections 4, 5

Latitude:
Longitude:
Core length: 471 cm
Water Depth:
Date taken: 8//13
Date opened: 8/30/13
Date described: 8/30/13
Date photographed: 8308/13
Described by: McHugh
Flow-in: no



271 - 471 cm [Diatomaceous Clayey Silt], grayish olive (7.5Y 4/2), olive black 7.5Y3/1
PC20 is characterized by very thin (< 3 cm) to thin (> 3 cm - 10 cm) beds of sandy silt and clayey silt, and fine to coarse sand laminae and lenses
The beds, laminae and lenses have sharp basal contacts.
The upper contacts are sharp, scoured (angular or wavy) and rarely gradational with bioturbation.
Beds have color variability ranging from grayish olive (7.5Y 4/2) to grayish olive (7.5Y 5/2) to olive black (7.5Y 3/1).

Ash sand laminae at 309 cm

Fine grained sand laminae are present at: 283-286 cm, 287, 290, 299-301 cm. 309, 321, 323, 326, 341, 348-352 cm. Sand is black 7.5Y 2/1

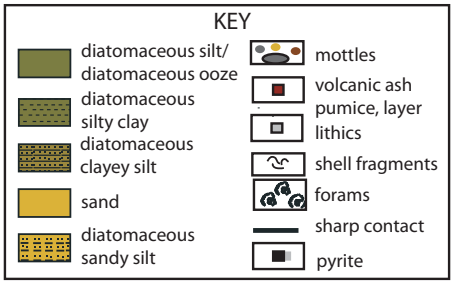
Rare to no bioturbation from 271 - 471 cm

Shells present at 300 cm, 320, 335, 352 cm. Shell fragments tend to be present within the sand beds, lamiane and lenses

Sand at 380, 399 cm

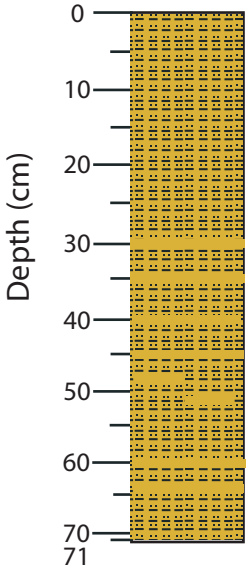
Wavy upper contact at 408 cm

Rip-up clasts are common, for example at 435 cm.



NT13-19-PL20 Section 1

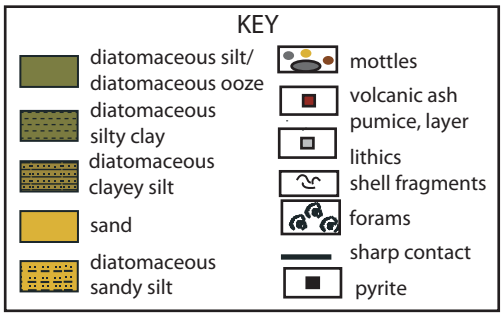
Latitude: Longitude:
Core length: 71 cm Water Depth:
Date taken: 8//13 Date opened: 8 / 3 0 / 1 3
Date described: 8/30/13 Date photographed: 8 / 3 0 / 1 3
Described by: McHugh Flow-in: no

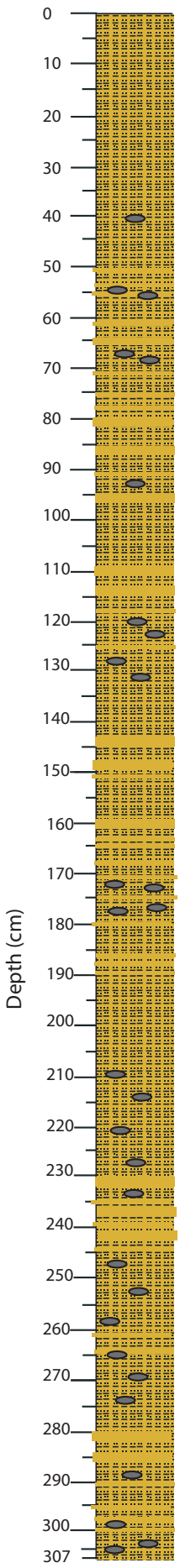


0 - 71 cm [Diatomaceous Sandy Silt], grayish olive 7.5Y 4/2

Sandy silty clay has thin (> 3 cm - 10 cm) and very thin (> 3 cm) beds
Basal contacts are sharp and upper contacts sharp and sometimes scoured

Fine grained sand laminae are present at 30 cm, 35 cm, 40-45 cm, 60-64 cm
Fine grained sand lenses at 48 cm and 52 cm





NT13-19-PC021- Sections 1, 2, 3, 4

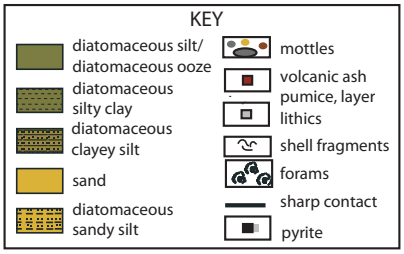
Latitude:	Longitude:
Core length: 367 cm	Water Depth:
Date taken: 8//13	Date opened: 9 / 1 / 1 3
Date described: 9/1/13	Date photograph: 9 / 1 / 1 3
Described by: McHugh	Flow-in: no

0-367 cm [Diatomaceous Sandy Silt], dark olive (7.5Y 4/3)
upper 10 cm soupy
PC21 has abundant sand (the most sand in any core we recovered during NT13-19 trip.
The sand is fine grained and present as sand beds, laminae, lenses, and disseminated sand.
The basal contacts are always sharp and can be "v" shaped,
and most of the upper contacts are sharp as well.
Bioturbation and mottling are slight and is associated to few gradational upper contacts.
The color of the core is dark olive 7.5Y 4/3 for the main lithology and
grayish olive 7.5 5/3 for the intervals that contain mottling.
Shell fragments are rear but some sand contains foraminifers.

Sand beds: 65, 66, 81-82, 86-87, 95-97 cm
Disseminated sand 99-110 cm
Sand laminae: 52, 53, 54, 61, 62, 64, 73, 75, 77, 79-80, 93, 94 cm
Mottling intervals: 41 cm, 55-58 cm, 66-68 cm, 91-92 cm

Sand beds: 110- 113, 144-145 cm, 147-148 cm, 161-163 cm
Disseminated sand: 135-142 cm, 157=160 cm, 190-193 cm, 205-210 cm
Sand laminae: 114, 115, 117, 118 cm, 126 cm, 150, 153, 154, 155, 157, 163, 164, 165, 167, 168 cm
172, 175, 180, 182, 184, 186, 188, 189, 190 cm
Shell fragments: 195cm
Mottling intervals: 120-125 cm, 128-130 cm, 170-173 cm,
175-180 cm

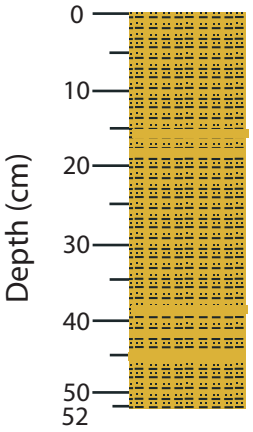
Sand beds: 231-233 cm, 236-238 cm, 240-241 cm, 281-282 cm, 282-283 cm
Sand laminae: 236, 239, 243, 244, 262, 263, 264, 284, 290-294, 298-299 cm, 294-295 cm.
Shell fragments 304-305 cm
Mottling intervals: 210-231, 233-235 cm, 244-260, 265-275 cm, 284-290 cm,
297-298 cm, 300-307 cm



NT13-19-PL21 Section 1, CC

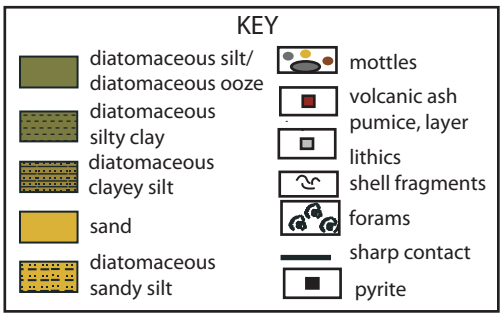
Latitude:
Core length: 52 cm
Date taken: 8//13
Date described: 9/1/13
Described by: McHugh

Longitude:
Water Depth:
Date opened: 9 / 1 / 13
Date photographed: 9 / 1 / 13
Flow-in: no



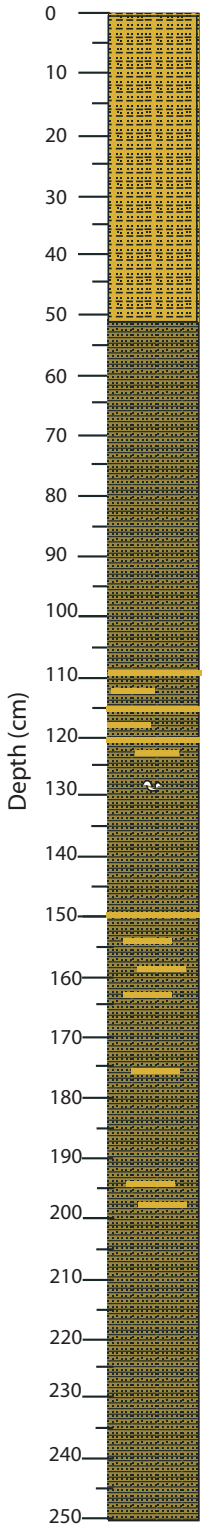
0 - 52 cm [Diatomaceous Sandy Silt], dark olive 7.5Y 4/3

Fine sand laminae at 16, 17, 38, 39, 40, 44, 45, 46 cm
Disseminated sand 47 - 50 cm



NT13-19-PC022- Sections 1, 2, 3

Latitude: Longitude:
Core length: 555 cm Water Depth:
Date taken: 8/27/13 Date opened: 8/29/13
Date described: 8/29/13 Date photographed: 8/29/13
Described by: McHugh Flow-in: no



0-50 cm [Diatomaceous Sandy Silt], homogeneous, grayish olive (7.5Y 4/2)
upper 5 cm soupy

50 - 250 cm [Diatomaceous Clayey Silt], dark olive (7.5Y 4/3)

50 - 70 cm evidence for dewatering with formation of breccia-like clasts

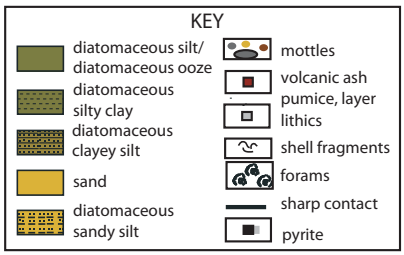
110 - 120 cm fine to medium sand interval containing laminae and lenses

Shell fragments at 130 cm

Fine sand at 149 - 150 cm
150 - 250 cm [Diatomaceous Clayey Silt],
homogeneous, grayish olive (7.5Y 4/2)

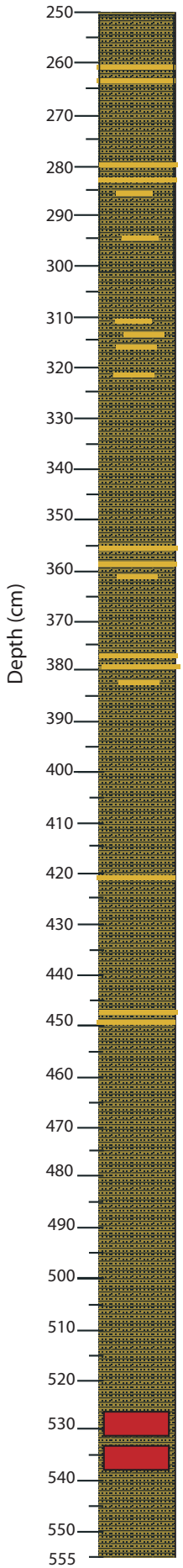
This section is characterized by containing
medium to coarse sand mostly as lenses and rare to common mottling and bioturbation. But the sediment is much ligher in color, gray 7.5Y 5/1 and grayish olive 7.5Y 5/2 than in most other cores in this study

Sand at 152-153 cm, 157 cm, 163 cm, 177 cm and between 196-197 cm



NT13-19-PC022- Sections 4, 5, 6, CC

Latitude: Longitude:
Core length: 555 cm Water Depth:
Date taken: 8/27/13 Date opened: 8 / 2 9 / 1 3
Date described: 8/29/13 Date photographed: 8 / 2 9 / 1 3
Described by: McHugh Flow-in: no



250 - 350 cm [Diatomaceous Sandy Silt], homogeneous, grayish olive (7.5Y 4/2)

Coarse sand laminae at 261 - 262 cm, 280 cm, 283 cm
Lenses at 283 cm, 295, 313-316 cm and 332 cm.

Moderate to heavy mottling (bioturbation) throughout the section. Also as in other sections of this core the mottiling (bioturbation) features are lighter in color, gray 7.5Y 5/1 and grayish olive 7.5Y 5/2

350 - 450 cm [Diatomaceous Clayey Silt], homogeneous, grayish olive (7.5Y 4/2)

Rare laminae of fine sand: 356 - 358 cm. 377, 379. 421, 448, 449 cm
and lenses 362 cm, 381 cm

Common mottling and bioturbation. Also as in other sections of this core the mottiling (bioturbation) features are lighter in color, gray 7.5Y 5/1 and grayish olive 7.5Y 5/2

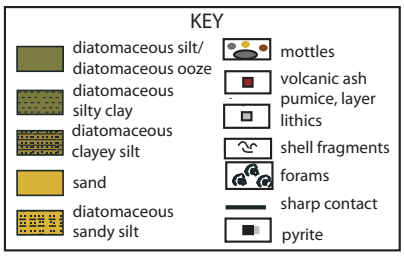
At 420 cm indurated rock 3 cm long

450 - 555 cm [Diatomaceous Clayey Silt]
Color changes observed: 450 - 475 cm, dark olive 7.5Y 4/3
475 - 490 cm, grayish olive 7.5Y 4/2
490 - 505 cm, dark olive 7.5Y 4/3
505 - 555 cm, gray 7.5Y 5/1

Sand medium to fine abundant: 461 - 481 cm, 468, 470, 472, 473, 475, 481- 482 cm
Also from 490 - 503 cm
Scattered sand lenses at 511 - 522 cm

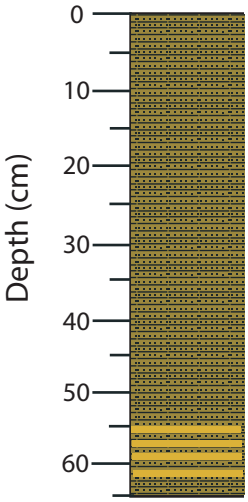
Ash bed, very fine grained sand to medium silt from 528 - 538 cm. Ash layer is cemented and light gray 7.5Y 7/1

The ash layer consists of two beds the basal unit from 534 - 537 cm. The upper unit from 528- 532 cm. This lower layer has a sharp basal contact that is marked by chevron-like folds and rip-up clasts. The upper contact is sharp.
The basal and upper layers are separated by 1-2 cm of clayey silt. The upper layer is cemented and has intrusion of the clayey silt into the basal contact. This basal contact is also sharp. Its upper contact is sharp but intruded from above by clayey silt.
A depositional process that explains the stratal relations is that shear occurred along the sea floor after deposition of the basal unit. The upper layer intrusions of clayey silt are most likely the result of compaction after its deposition. Increased pore fluids during the deposition of the ash layers most likely facilitated its cementation.



NT13-19-PL22 Section 1

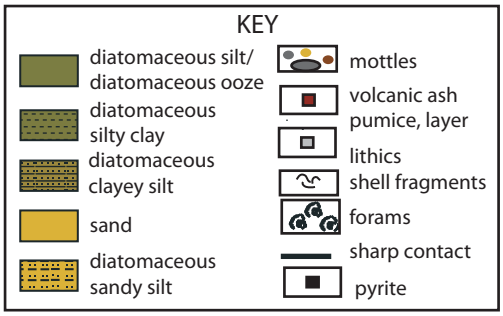
Latitude: Longitude:
Core length: 65 cm Water Depth:
Date taken: 8/27/13 Date opened: 8/29/13
Date described: 8/29/13 Date photographed: 8/29/13
Described by: McHugh Flow-in: no



0 - 65 cm [Diatomaceous Sandy Silt], dark olive 7.5Y 4/3

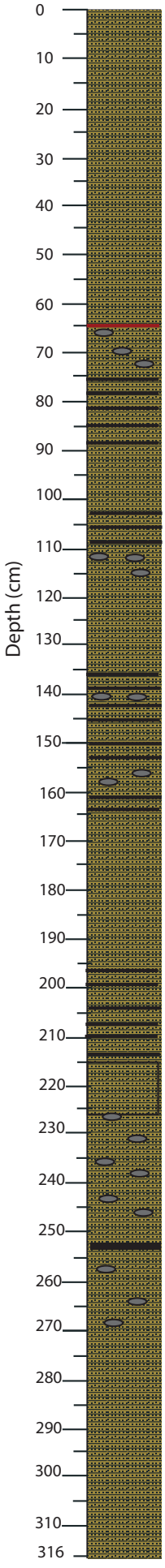
Very fine grained sand scattered throughout the section

Sand laminae present near th base



NT13-19-PC023- Sections 1, 2, 3, 4

Latitude: Longitude:
Core length: 316 cm Water Depth:
Date taken: 8/28/13 Date opened: 8/30/13
Date described: 8/30/13 Date photograph: 8/30/13
Described by: McHugh Flow-in: no



0-316 cm [Diatomaceous Sandy Silt], homogeneous, grayish olive (7.5Y 4/2)
upper 30 cm soupy

36 - 65 cm homogeneous diatomaceous clayey silt, grayish olive 5YR 4/2.
Very fine grained sand laminae at 65 cm, dark reddish brown 5YR 3/6.

66- 76 cm homogenoeus gray 7.5Y 4/1

76 - 90 cm homogenous olive black 7.5Y 3/1 bands

90 - 96 cm bands black 7.5 2/1
96 - 104 cm homogenous gray 7.5Y 4/1
104 - 109 cm black color bands 7/5Y 2/1
109 - 116 cm mottling black 7.5Y 2/1

116 - 136 cm olive black clayey silt 7.5Y 3/1

136 - 146 cm color banding and mottling, black 7.5Y 2/1
146-150 cm clayey silt homogeneous, gray 7.5Y 4/2

150 - 163 cm color banding and mottling black 7.5Y 2/1

166 - 196 cm clayey silt homogeneous, gray 7.5 Y 4/2

196 - 216 cm clayey silt has color banding black 7.5Y 2/1

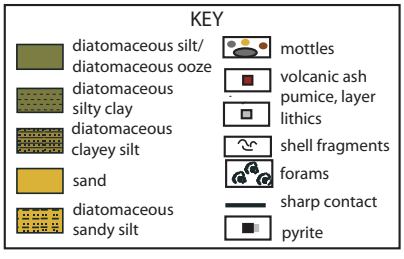
216 - 226 cm [Diatomaceous Clayey Silt]
Color banding: gray olive (7.5Y 4/2), gray olive (7.5Y 5/2), black (7.5Y 2/1)

226 - 253 cm mottling and bioturbation bray olive 7.5 4/2 and gray olive 7/5Y 5/2

253 - 254 cm black color band

254 270 cm mottling bioturbation

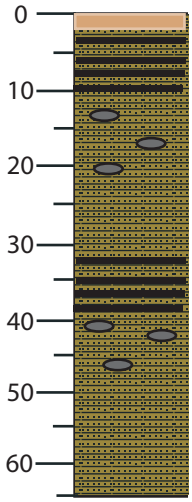
270 - 316 cm homogeneous clayey silt,
color darker towards the bottom from
grayish olive 7.5Y 4/2 to olive black 7.5Y 3/2



NT13-19-PL23 Section 1, CC

Latitude:
Core length: 65 cm
Date taken: 8/27/13
Date described: 8/29/13
Described by: McHugh

Longitude:
Water Depth:
Date opened: 8/29/13
Date photographed: 8/29/13
Flow-in: no

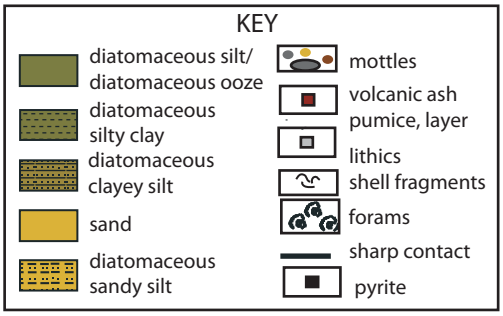


0 - 65 cm [Diatomaceous Clayey Silt], grayish olive 7.5Y 4/2

0-2 cm clayey silt grayish olive 5Y 4/2

2 - 10 cm color banding: olive black 7.5Y 3/1, grayish olive 7.5Y 4/2

10 -20 cm grayish olive 7.5Y 4/2 with black mottling
20-34 cm homogeneous olive black 7.5Y 3/1
34 - 38 cm color banding olive black 7.5Y 3/1, grayish olive 7.5Y 4/2
38-44 cm mottling black
44- 54 cm homogeneous clayey silt, olive black 7.5Y 3/1

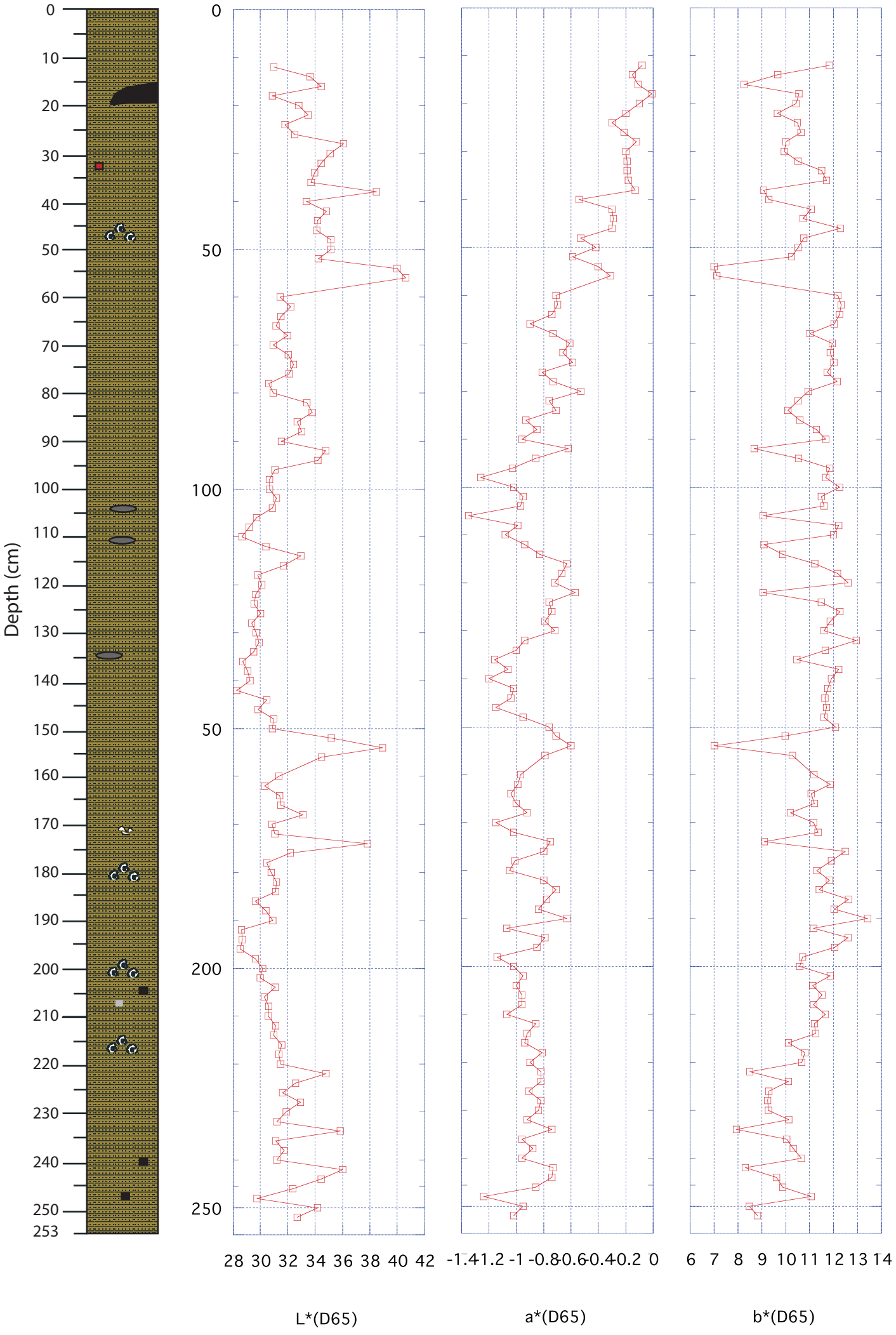


6. 4. Color spectroscopy

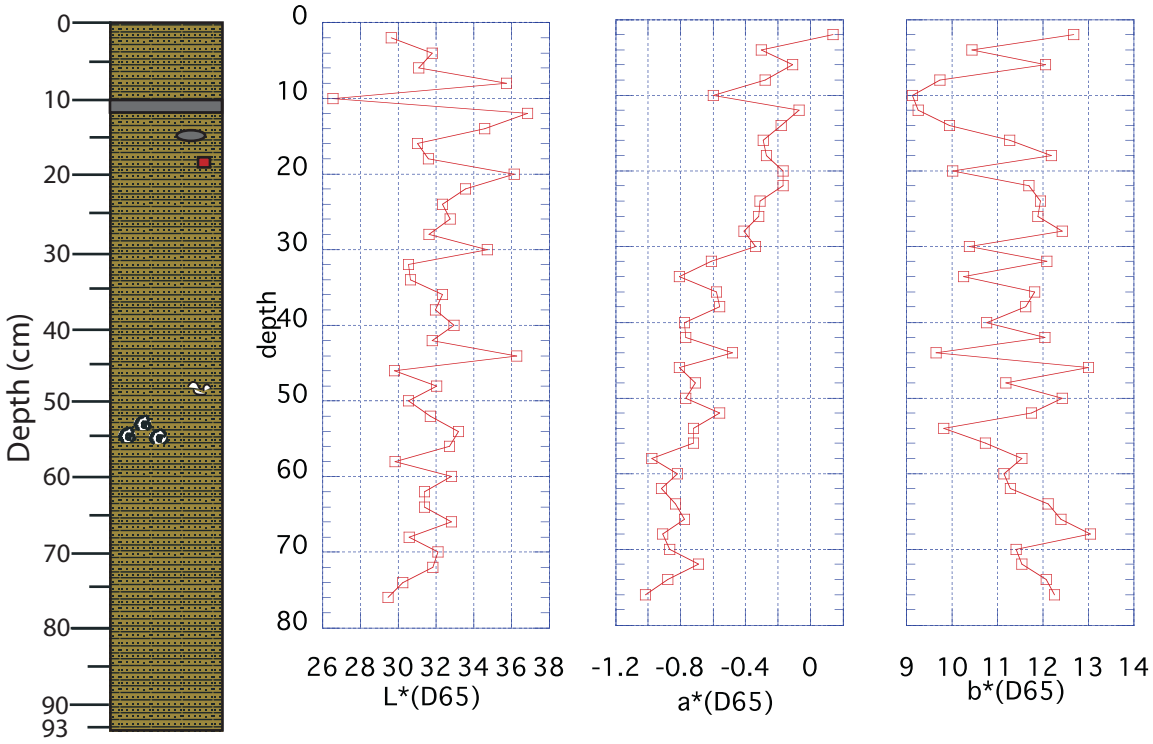
All the cores were measured for their reflectance spectra on fresh surfaces of the split core. The colorimetric information was recorded in the L*a*b* color space systems which expressed color as a function of lightness (L*) and color values a* and b* as mentioned on the Methods Section. The initial observations of the data plotted versus depth for each core show that small-scale variability at a centimeter scale dominates the signals. Longer-period trends are also revealed at the hundred of centimeter core length. Post-cruise analyses will extract more detailed information about these measurements.

All results of shipboard color measurements are presented in the next section.

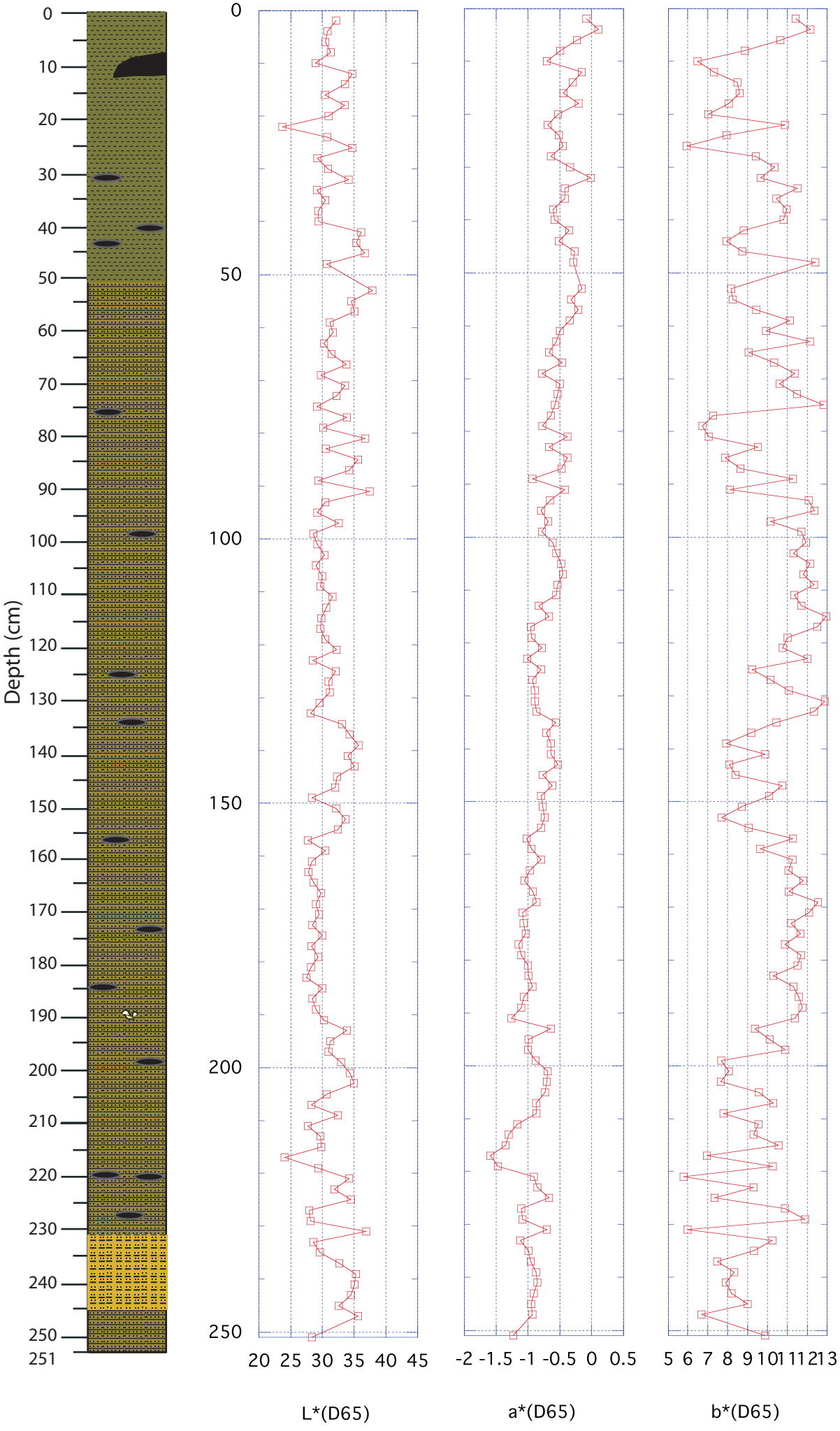
NT13-19-PC01- Sections 1, 2, 3



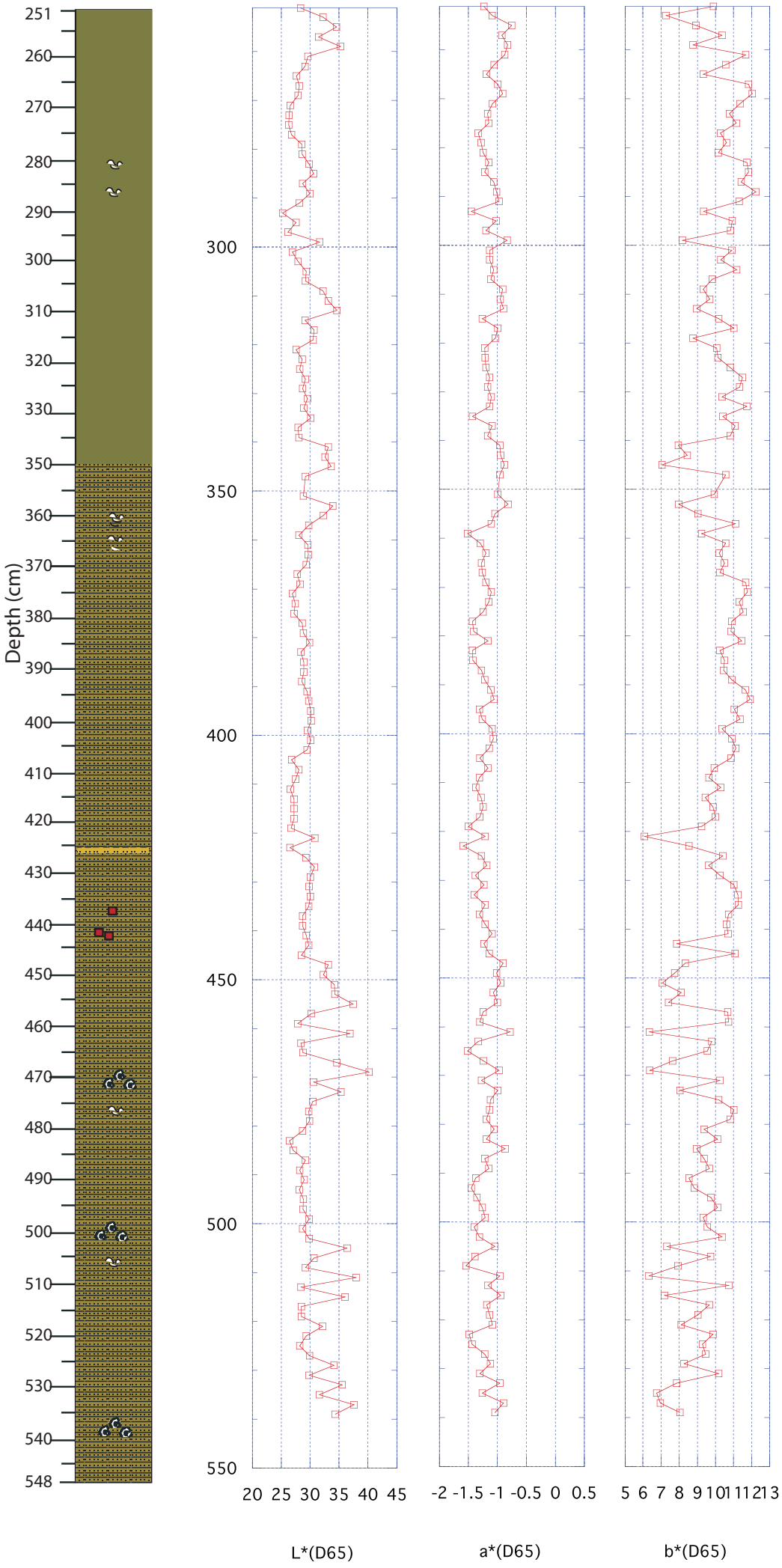
NT13-19-PL01 Sections 01, CC



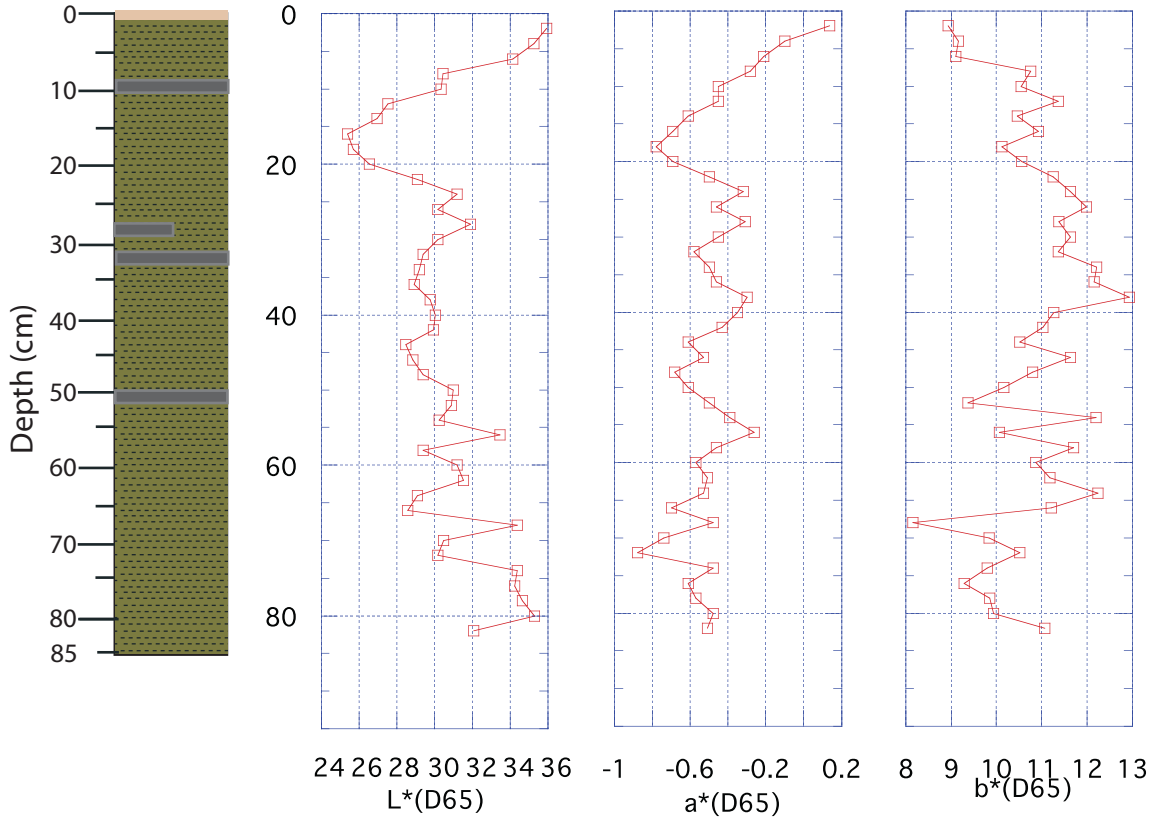
NT13-19-PC02- Sections 1, 2, 3



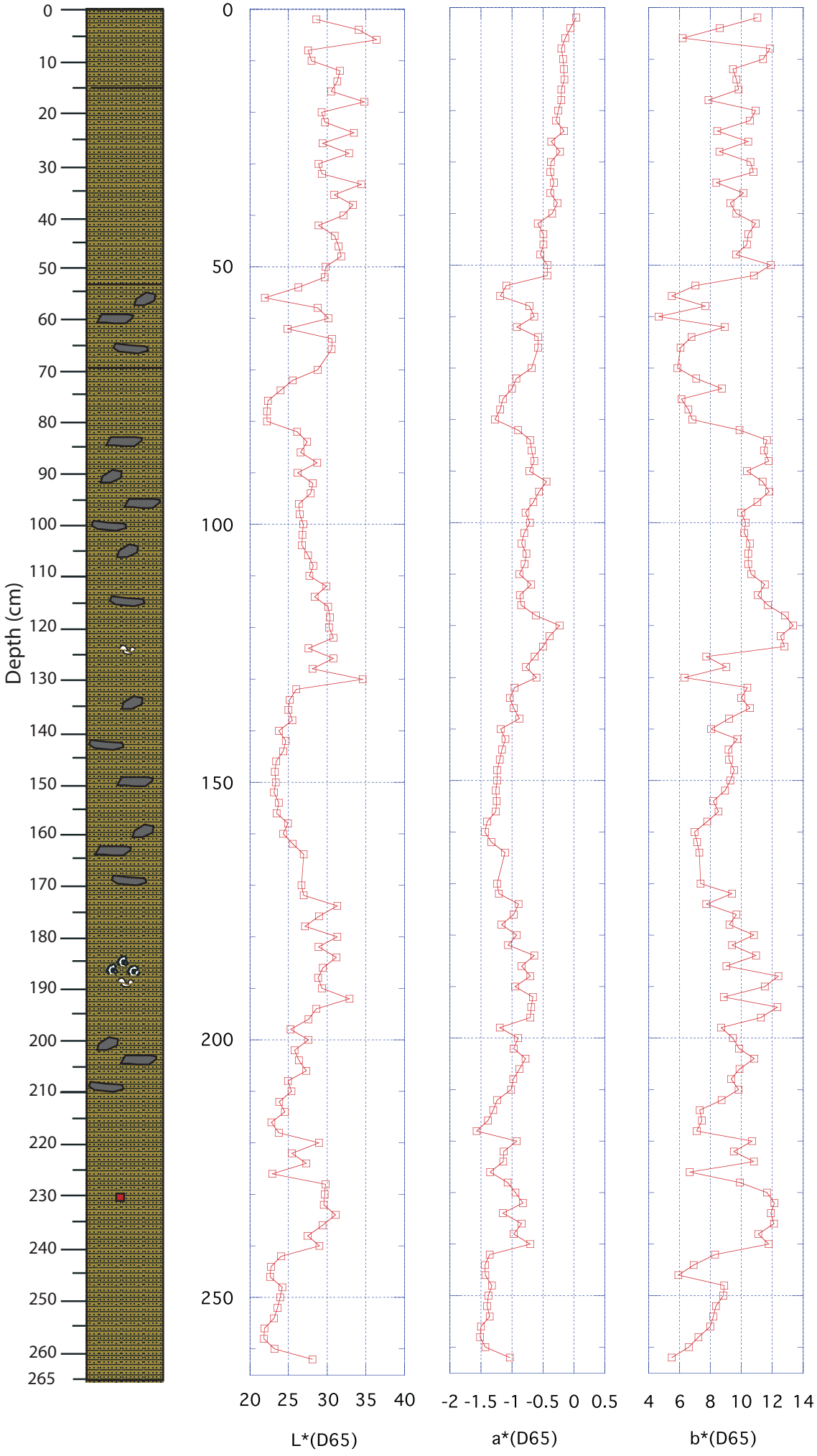
NT13-19-PC02- Sections 4, 5, 6, CC



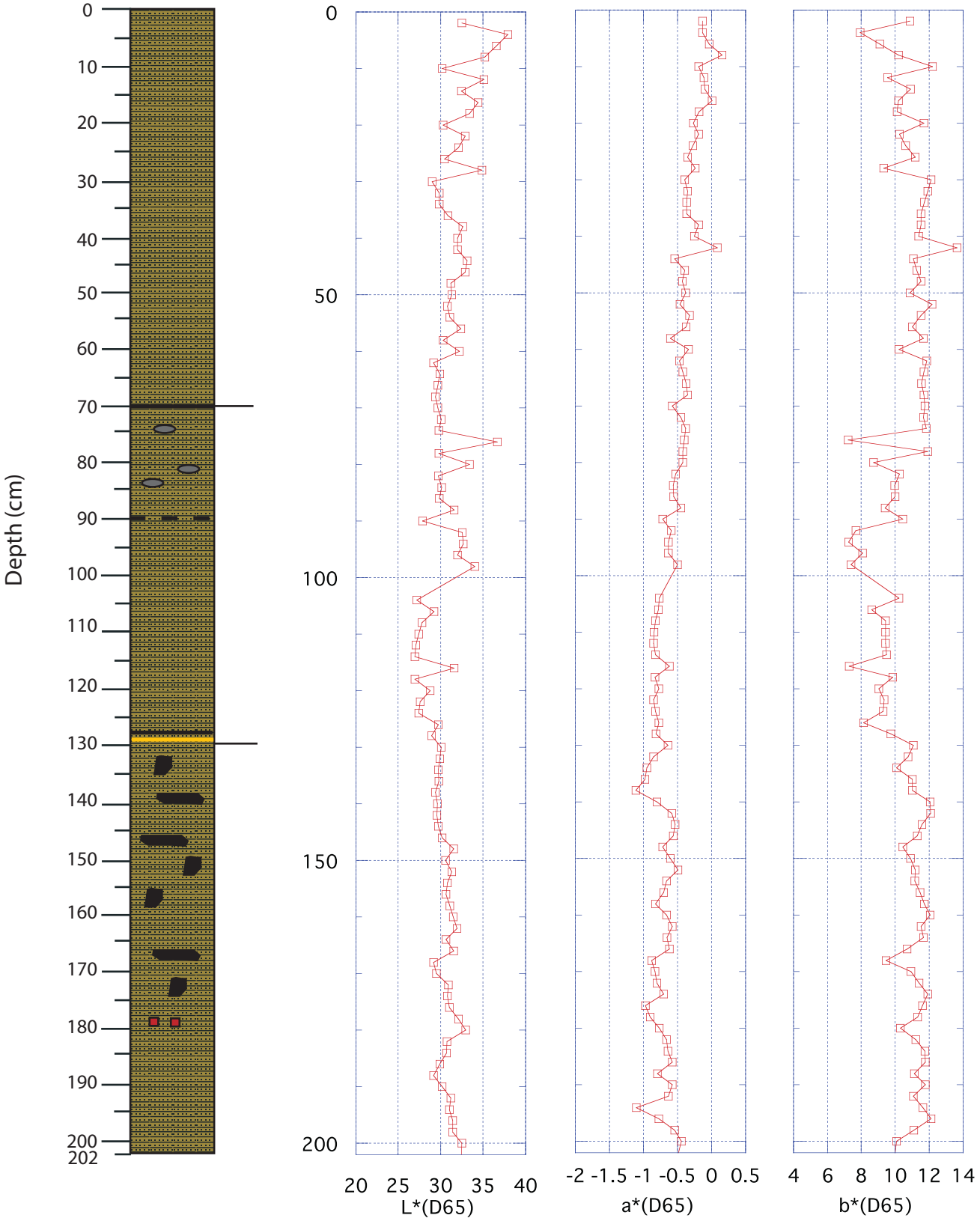
NT13-19-PL02


Depth (cm)
0
10
20
30
40
50
60
70
80
85
0
20
40
60
80
24 26 28 30 32 34 36
L*(D65)
-1
-0.6
-0.2
0.2
a*(D65)
8
9
10
11
12
13
b*(D65)

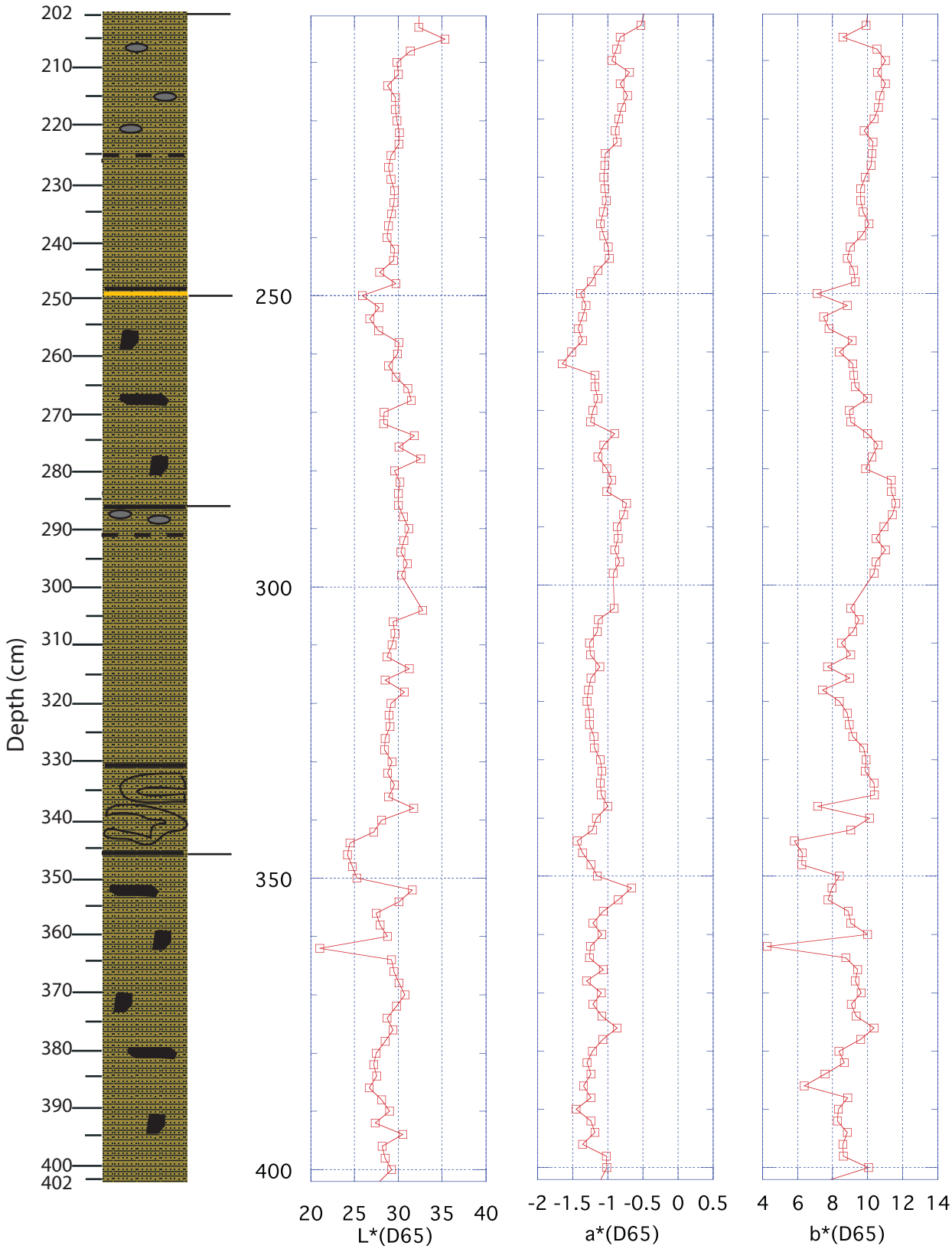
NT13-19-PC03- Sections 1, 2, 3



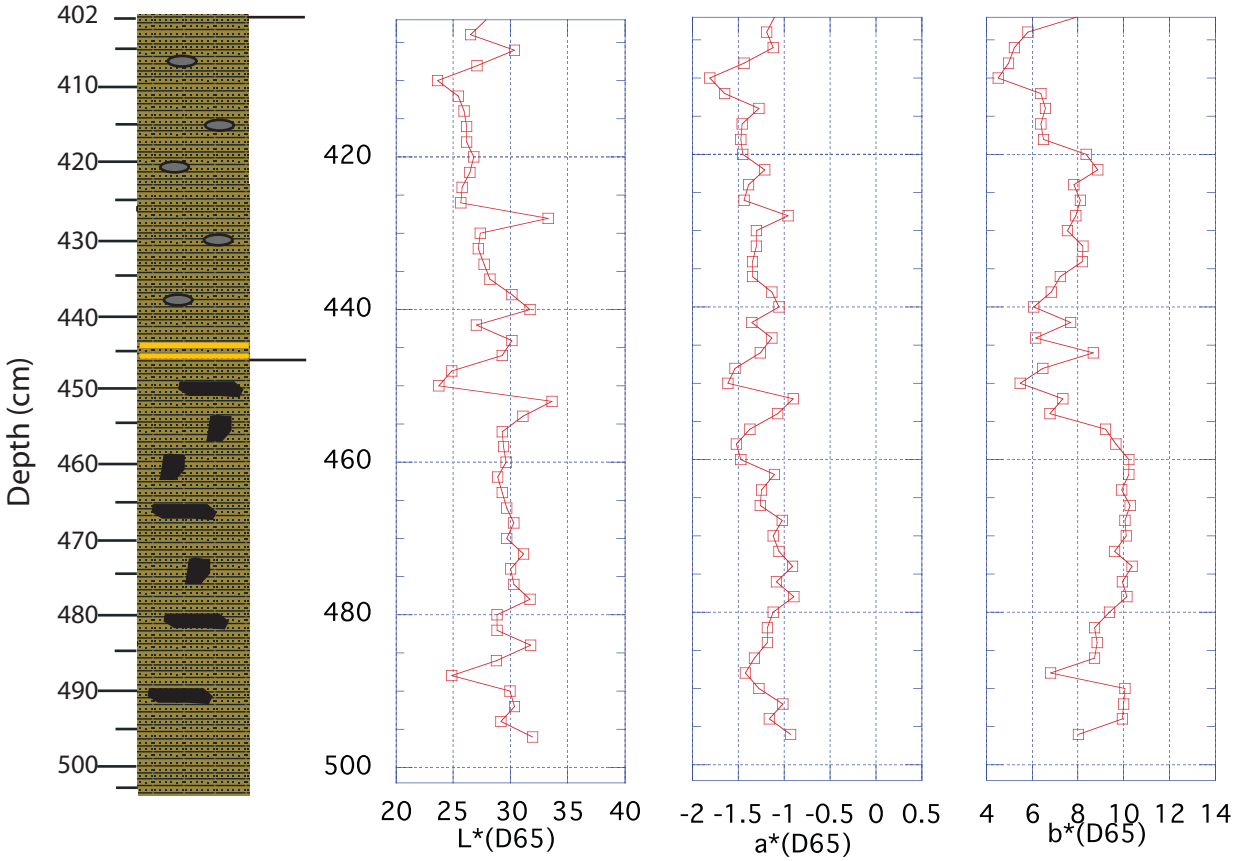
NT13-19-PC04- Sections 1, 2, 3

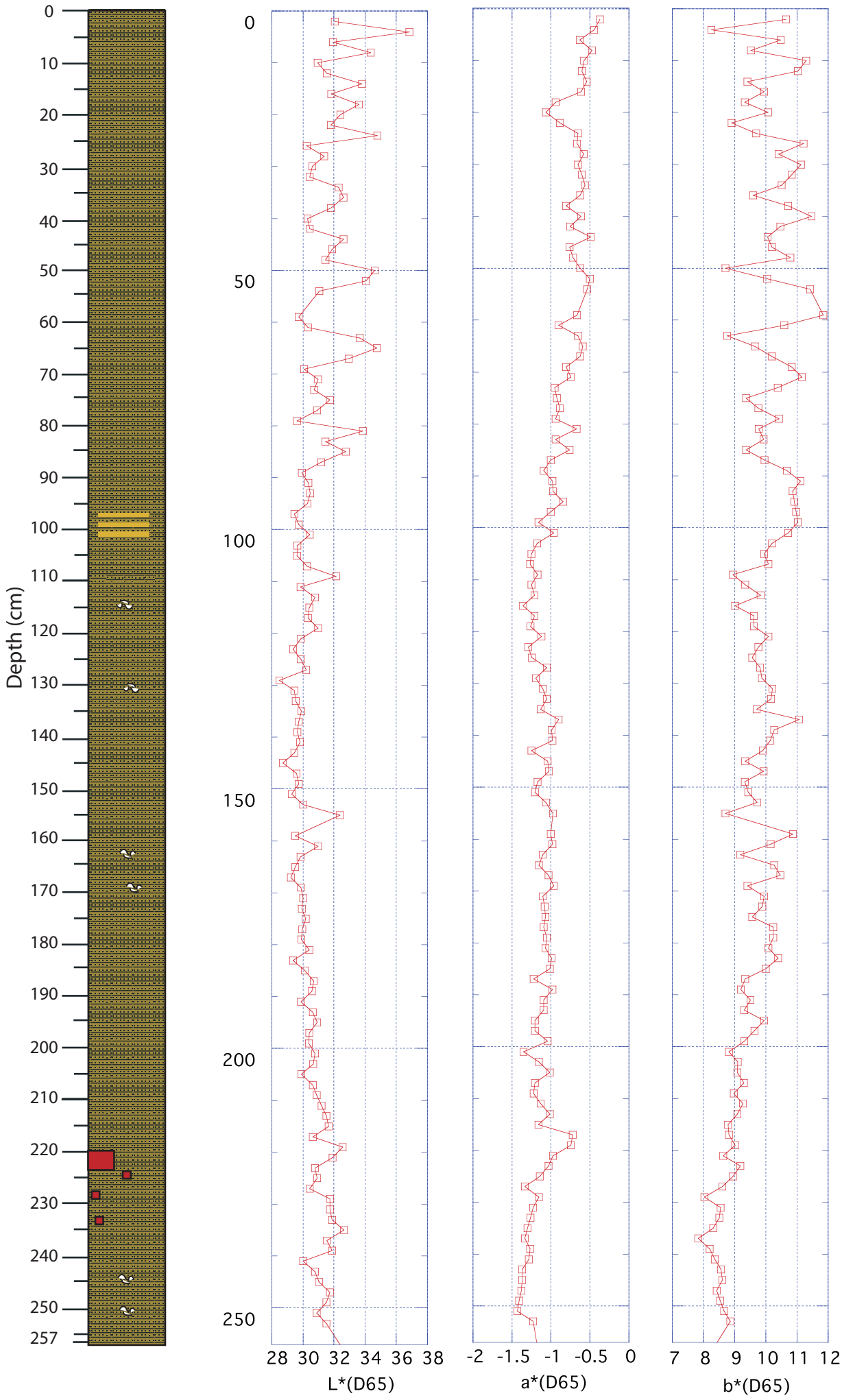


NT13-19-PC04- Sections 3, 4



NT13-19-PC04- Sections 5




NT13-19-PC05- Sections 1, 2, 3
Depth (cm)
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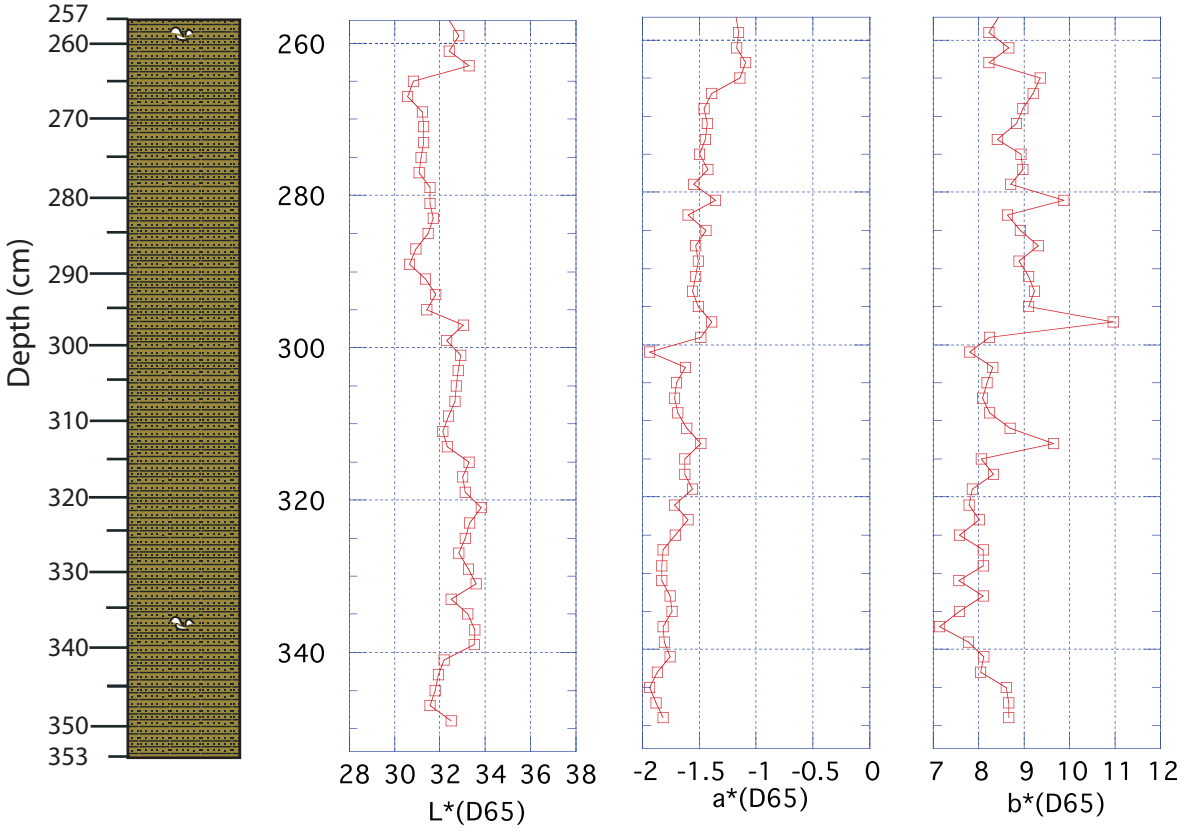
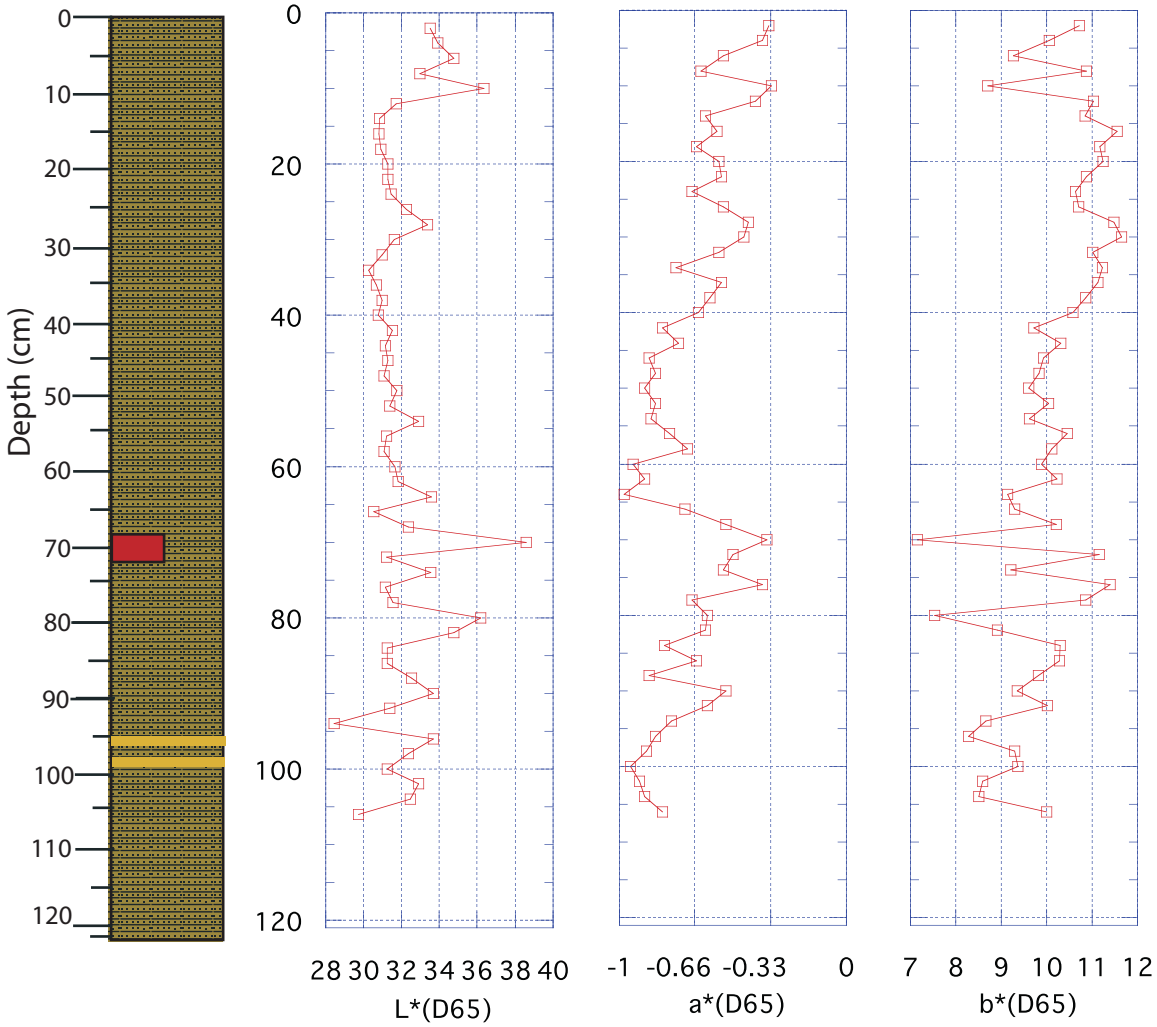
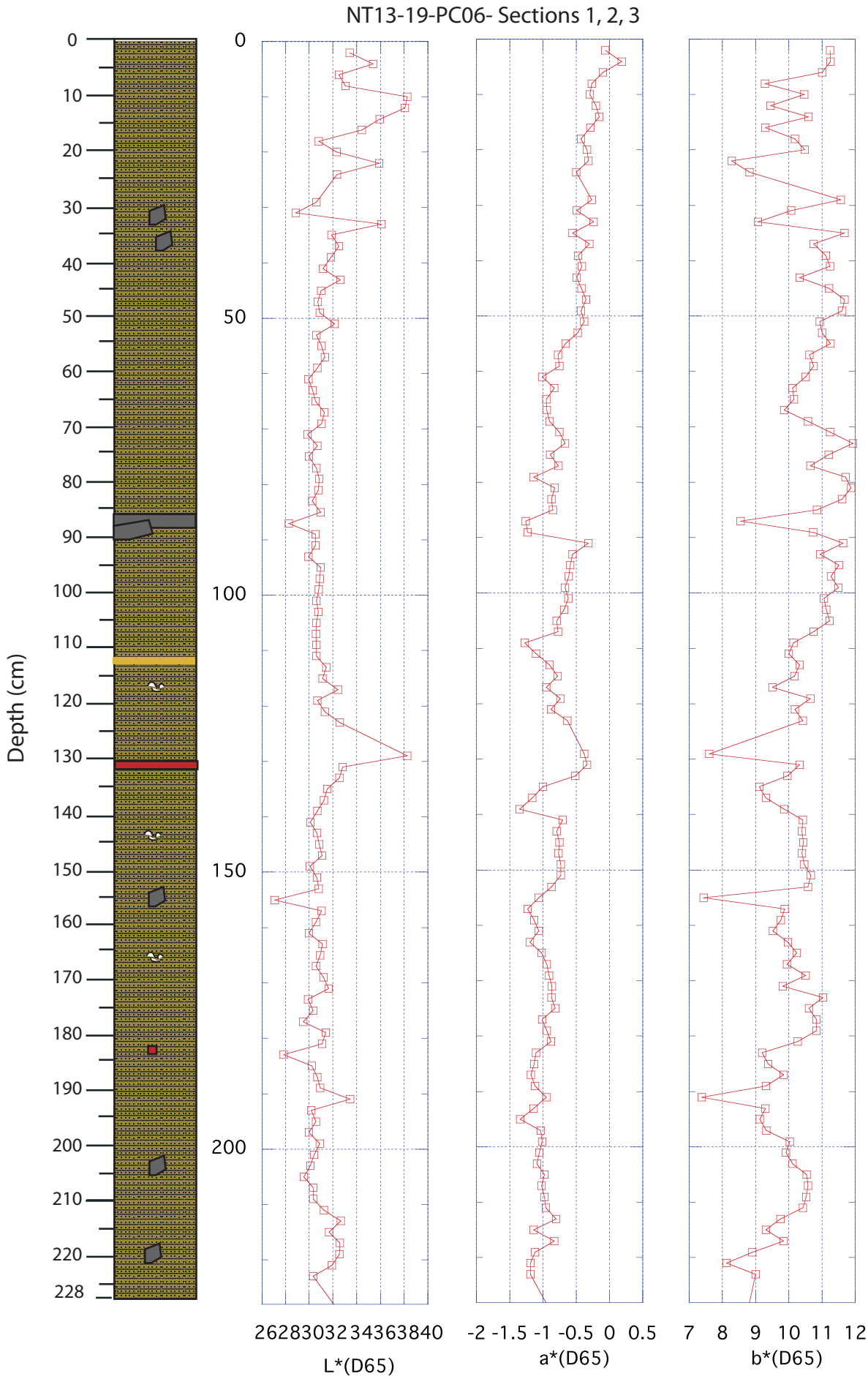
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
257
0
50
100
150
200
250
28 30 32 34 36 38
L*(D65)
-2 -1.5 -1 -0.5 0
a*(D65)
7 8 9 10 11 12
b*(D65)

NT13-19-PC05- Section 4



NT13-19-PL05 Sections 01, 2, CC




NT13-19-PC06- Sections 1, 2, 3
Depth (cm)
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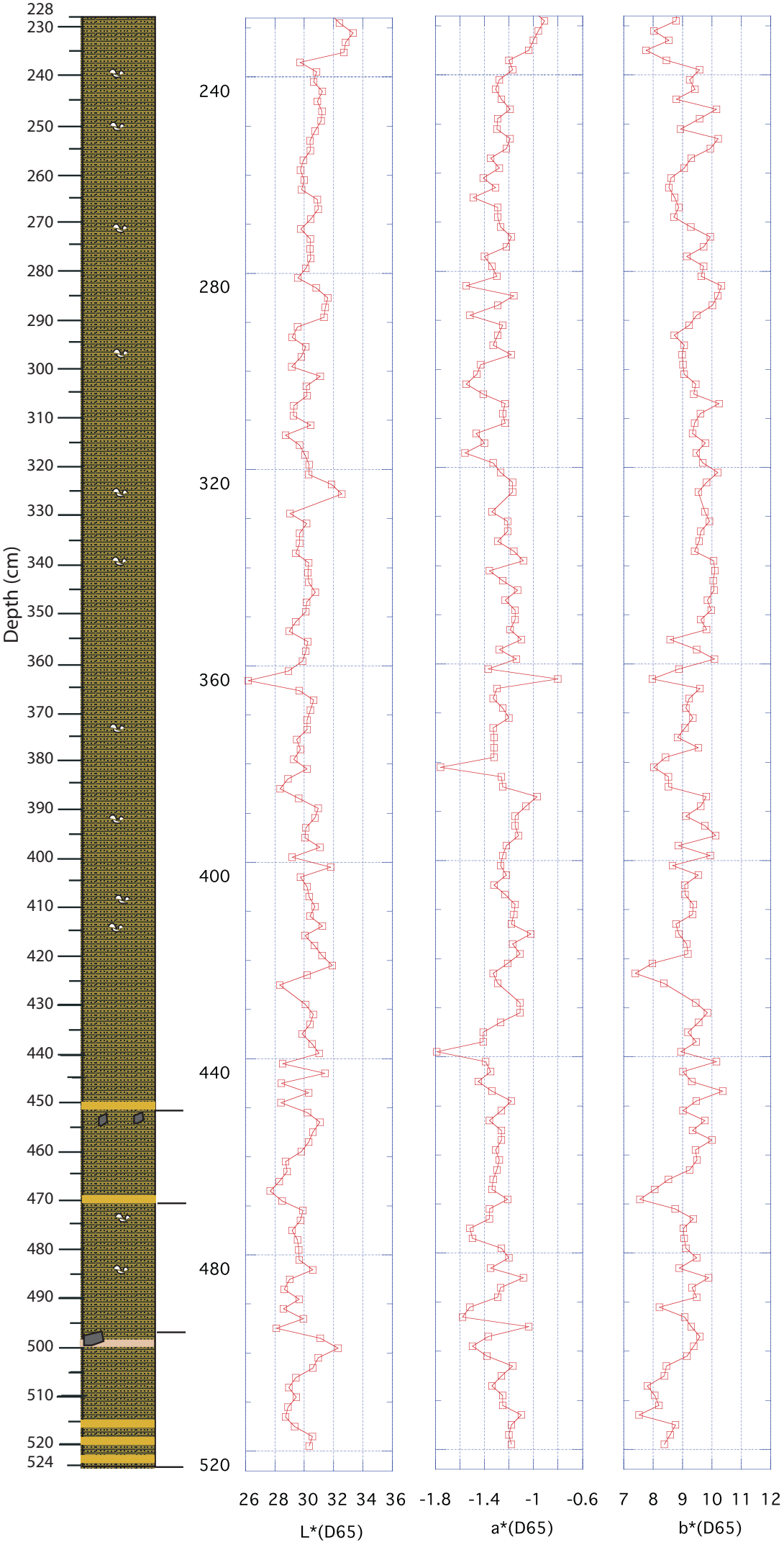
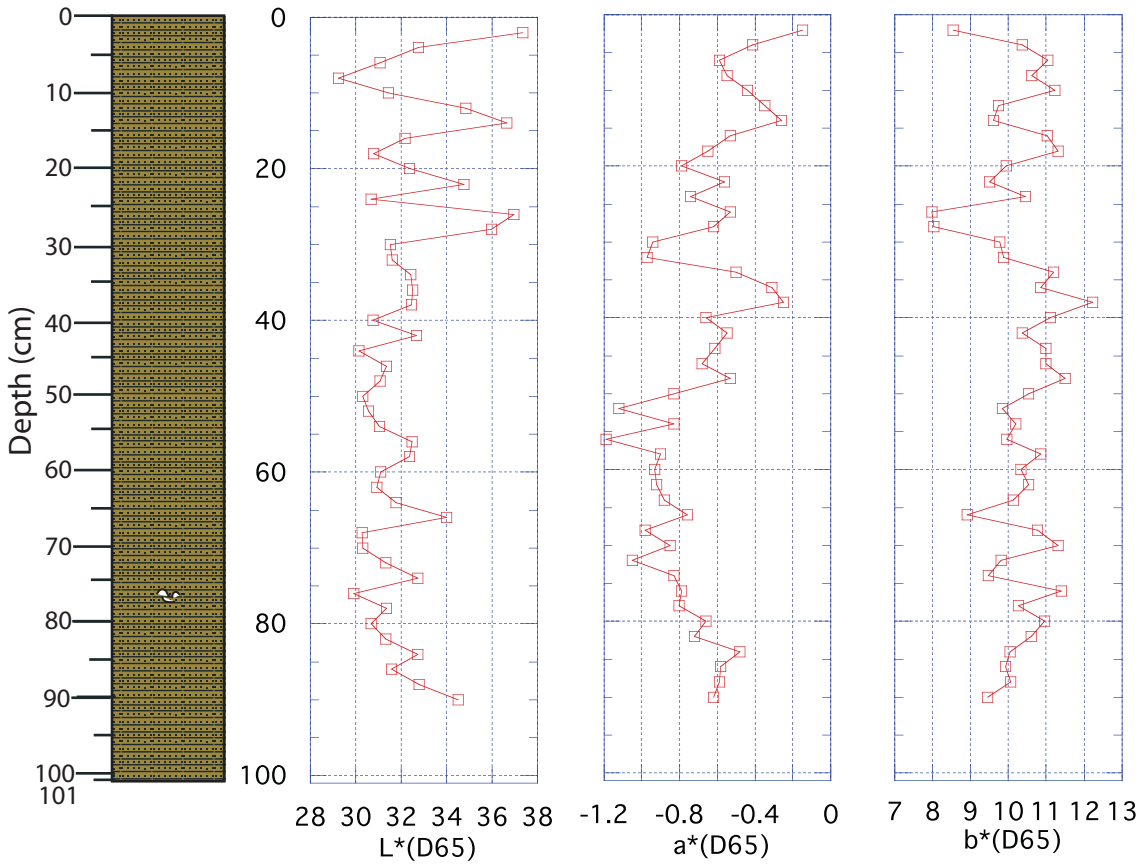
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
228
0
50
100
150
200
26
28
30
32
34
36
38
40
L*(D65)
-2
-1.5
-1
-0.5
0
0.5
a*(D65)
7
8
9
10
11
12
b*(D65)

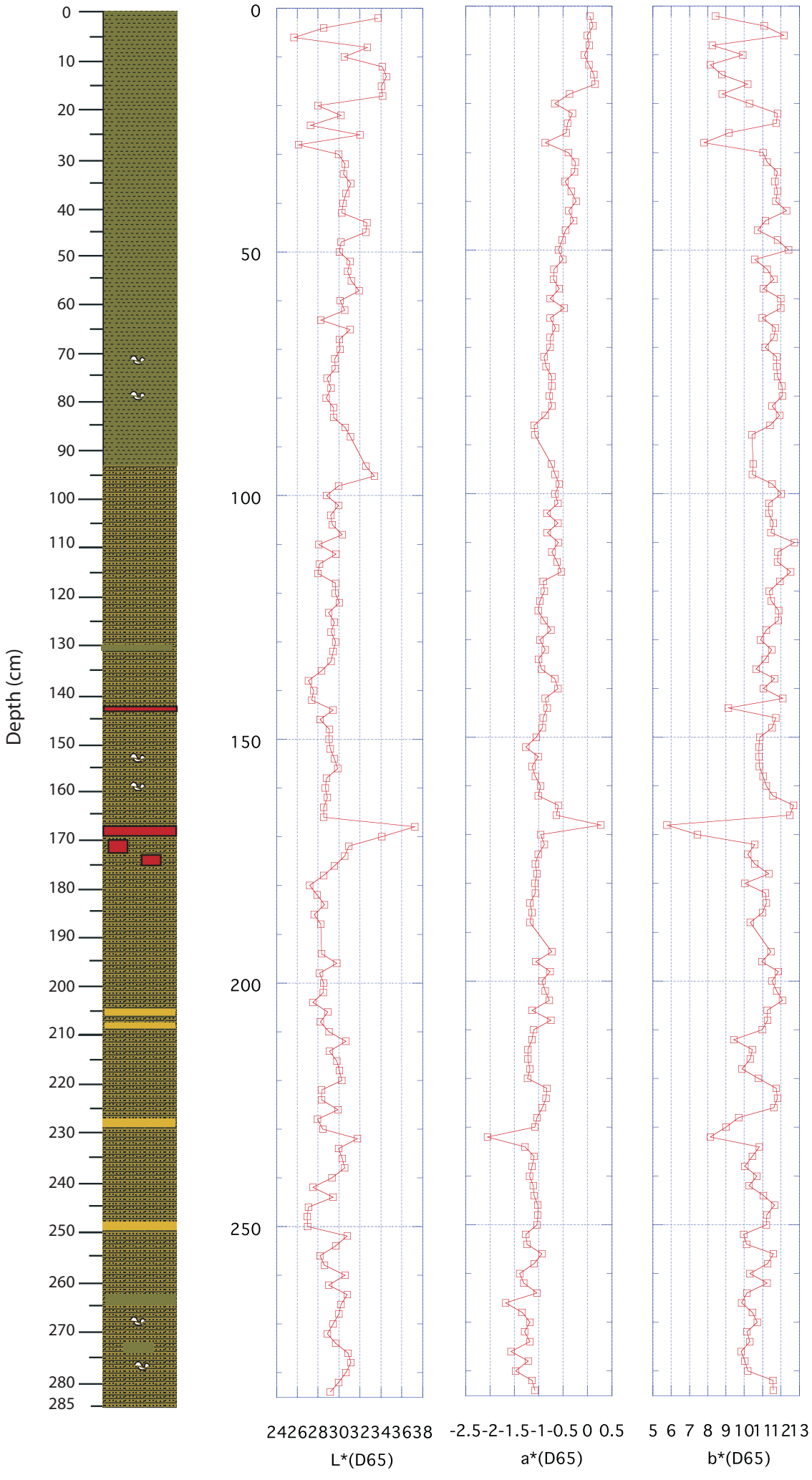
NT13-19-PC06- Sections 4, 5, 6



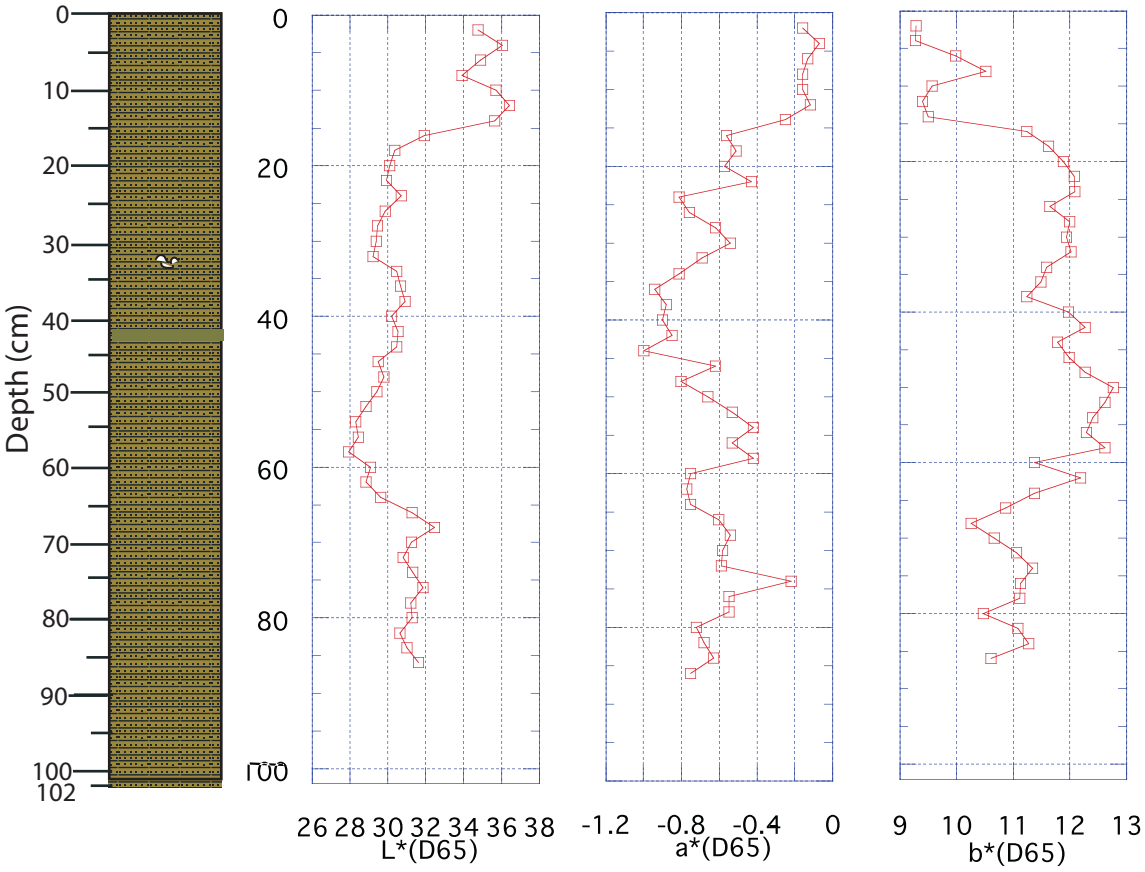
NT13-19-PL06 Sections 1, CC



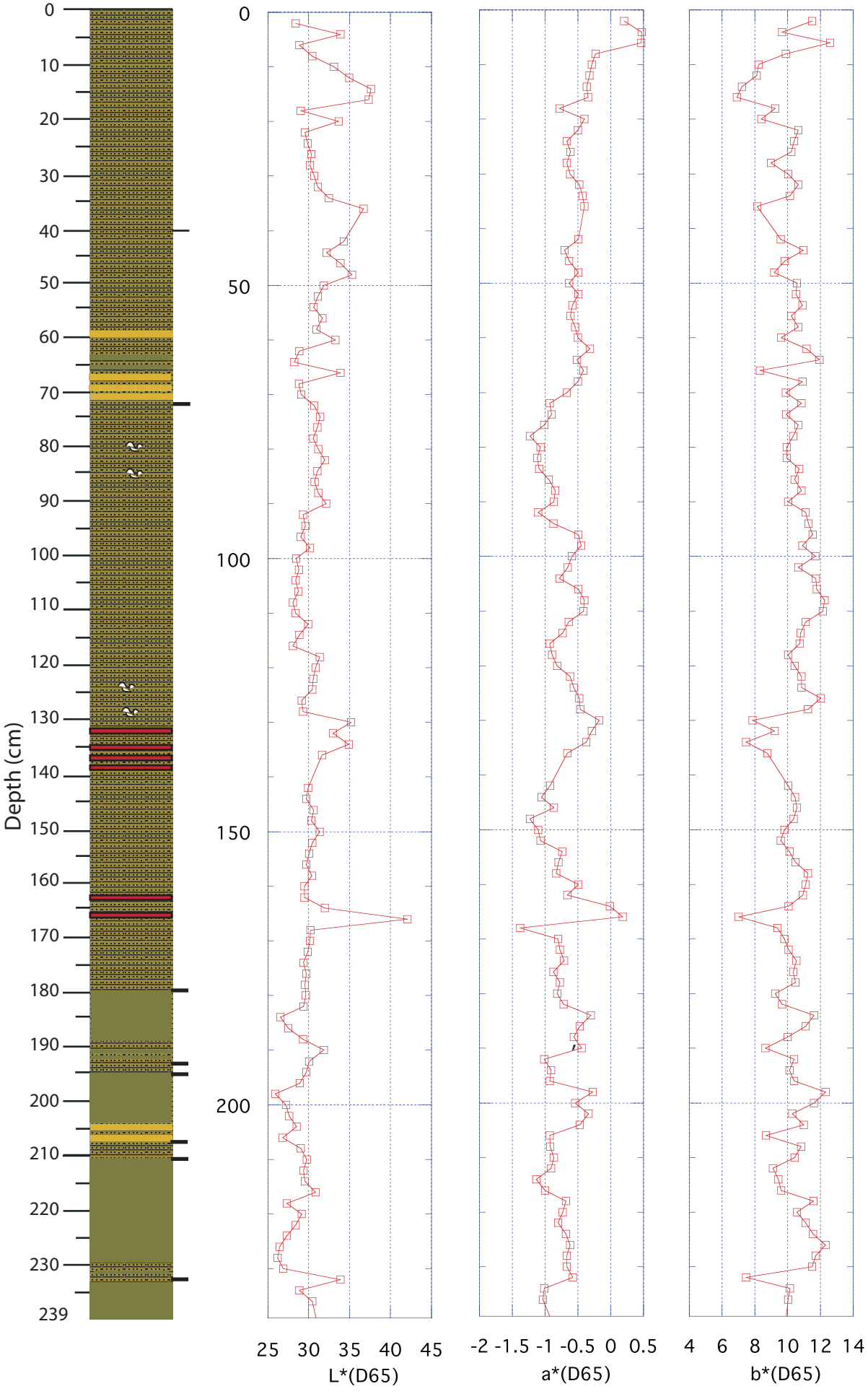
NT13-19-PC07- Sections 1, 2, 3



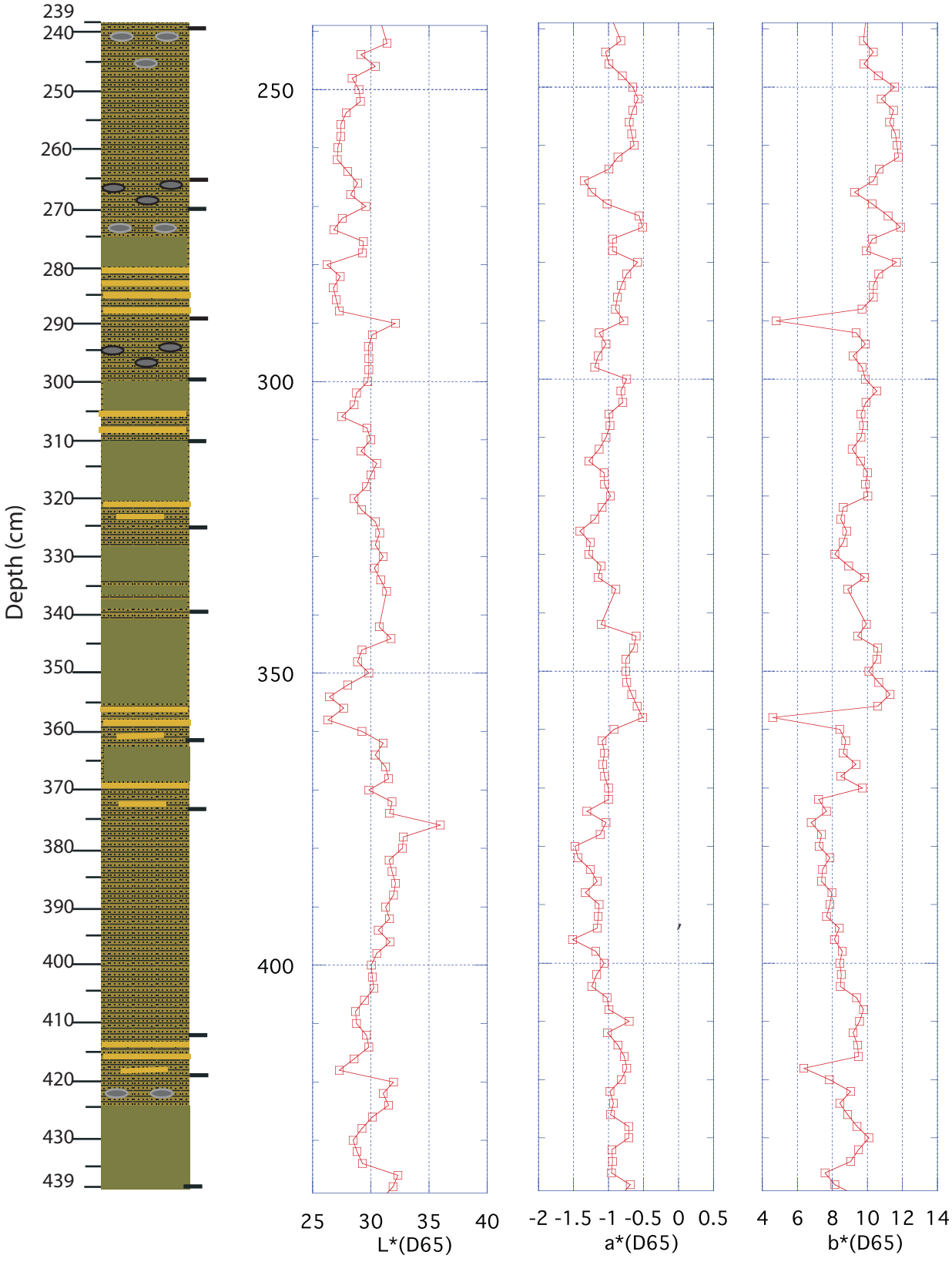
NT13-19-PL07 Sections 1, CC



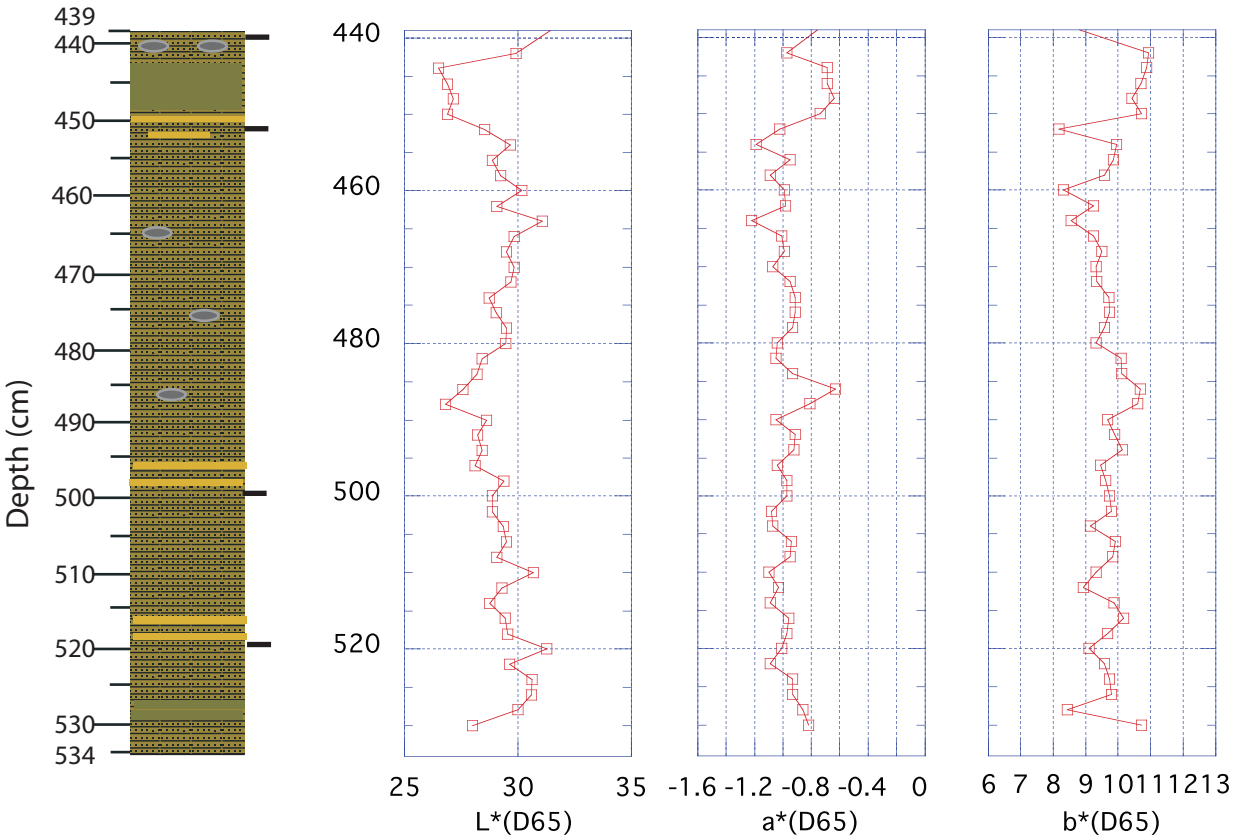
NT13-19-PC08- Sections 1, 2, 3



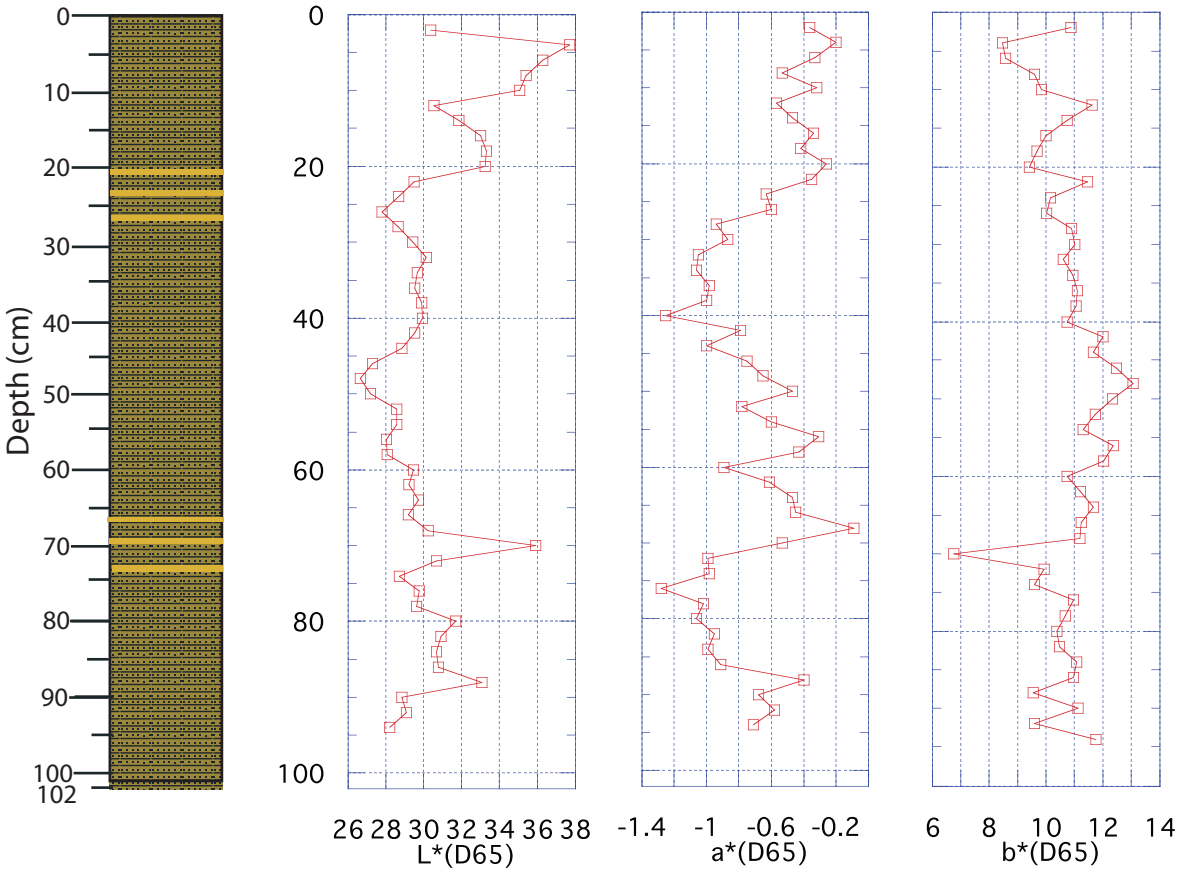
NT13-19-PC08- Sections 4, 5



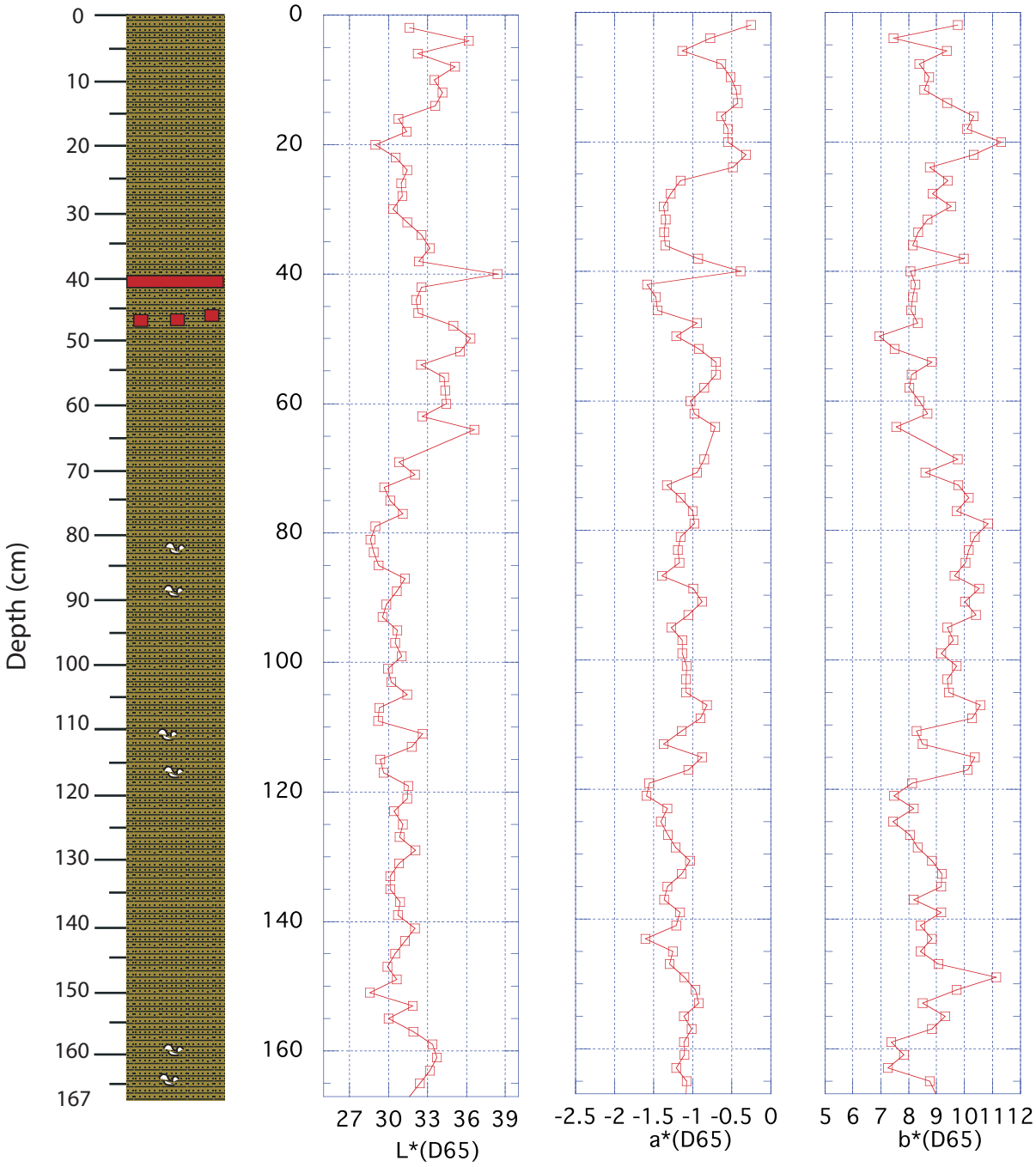
NT13-19-PC08- Sections 4, 5



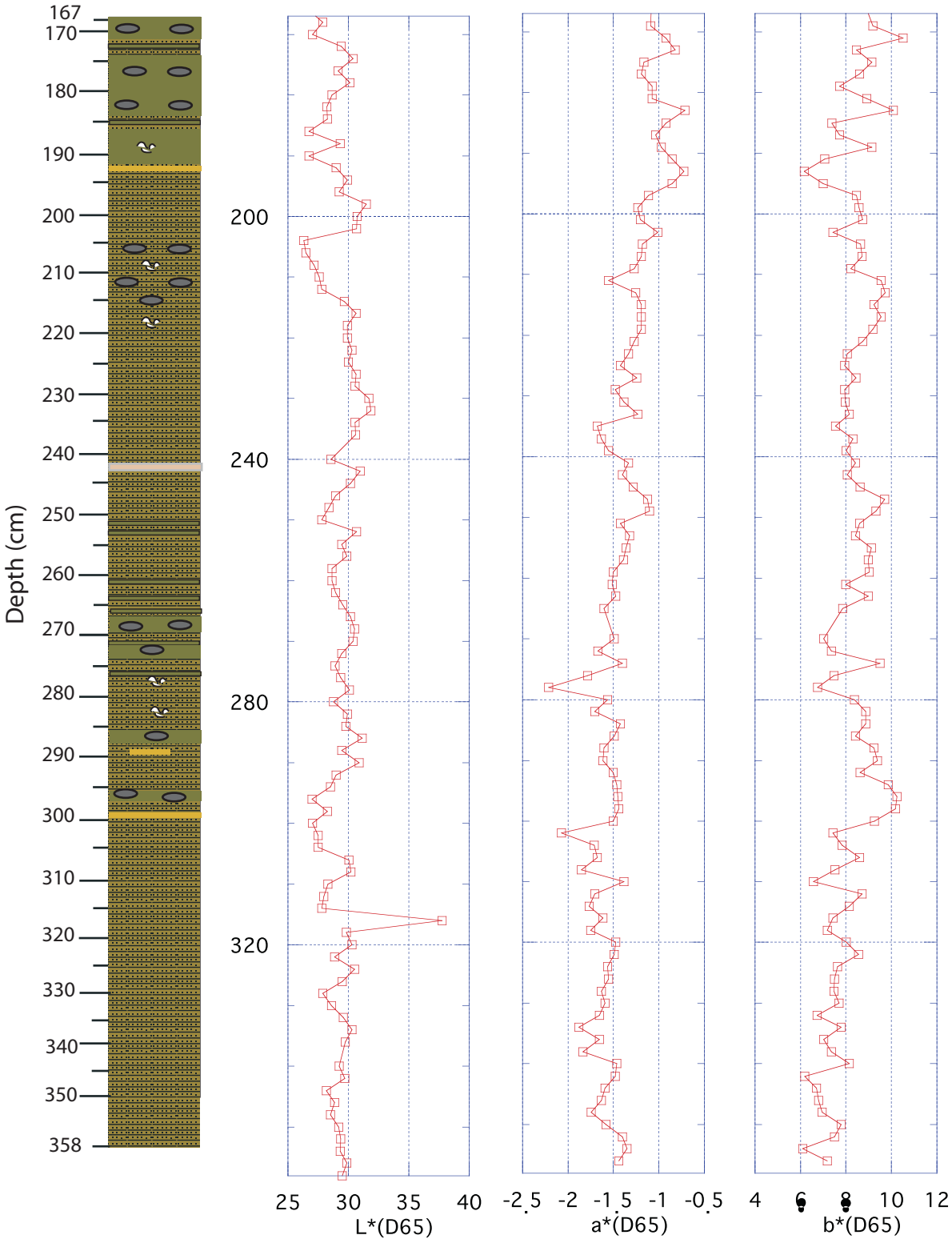
NT13-19-PL08 Sections 1, CC



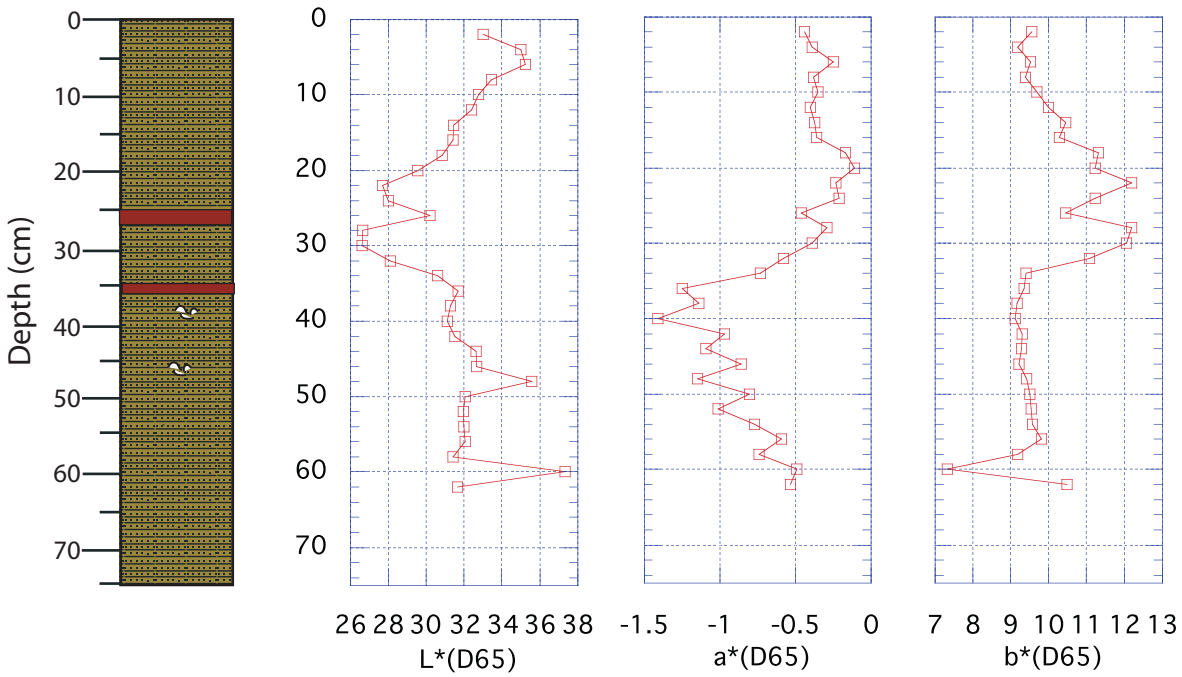
NT13-19-PC09- Sections 1, 2



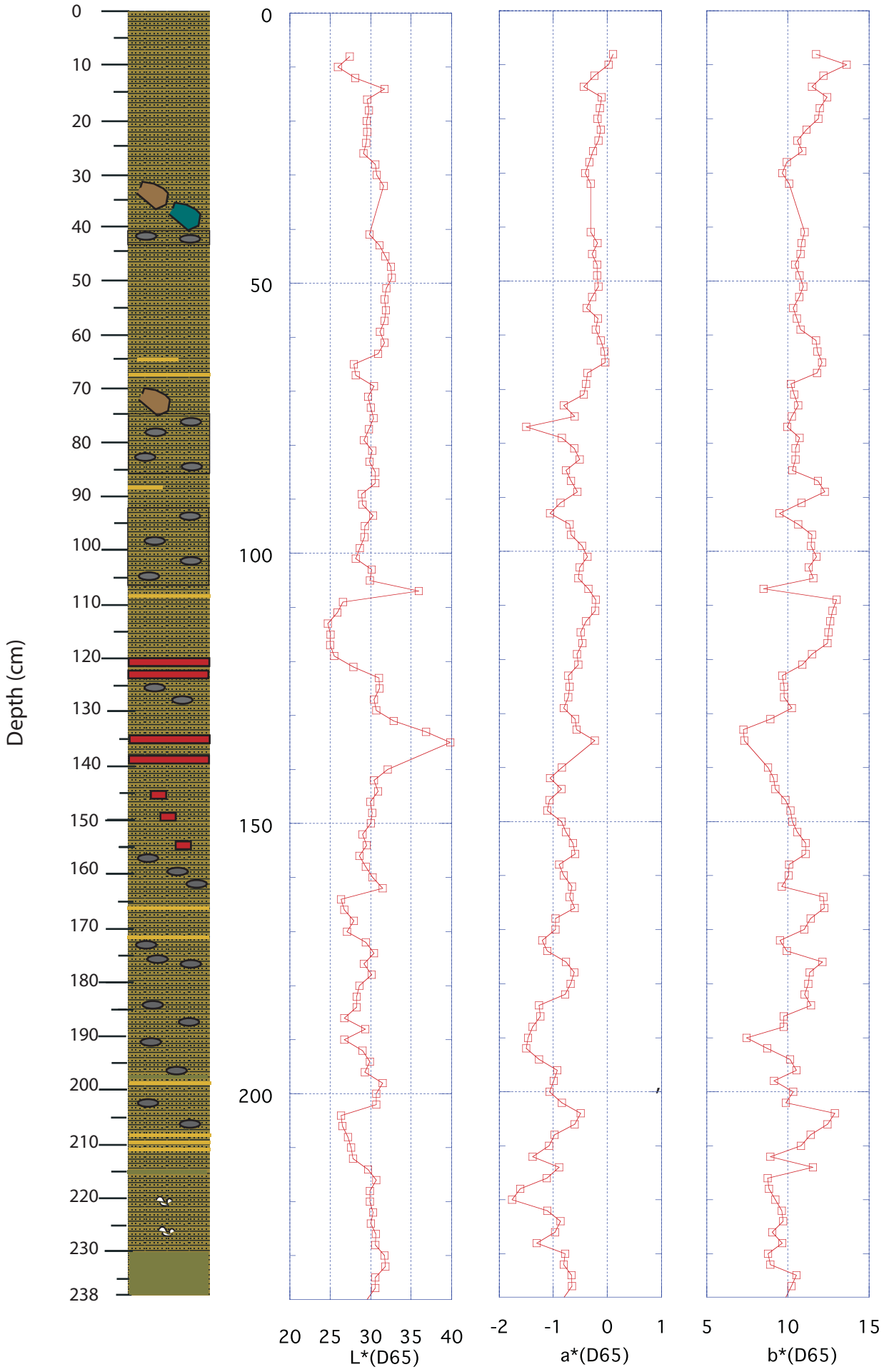
NT13-19-PC09- Sections 3, 4



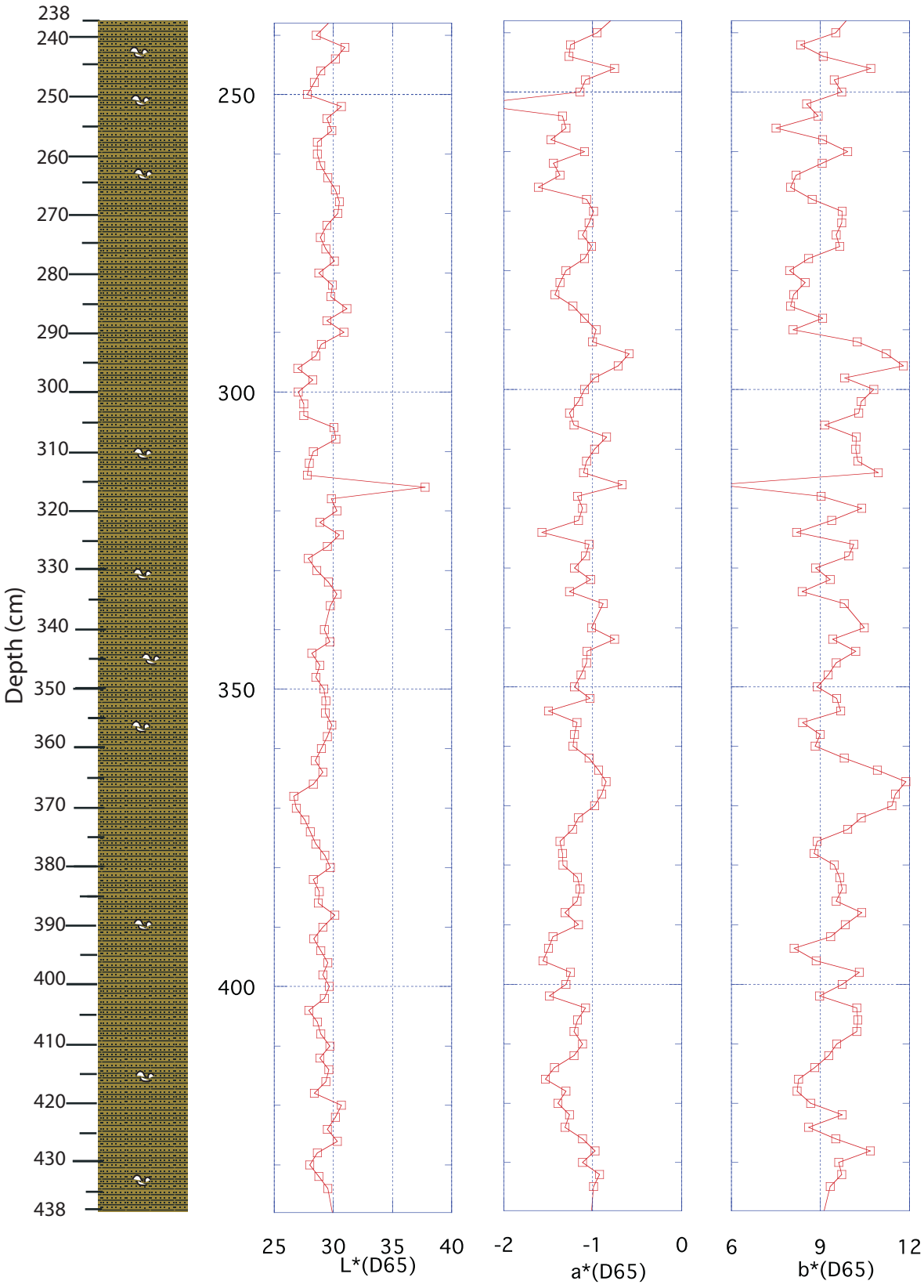
NT13-19-PL09 Sections 1, CC

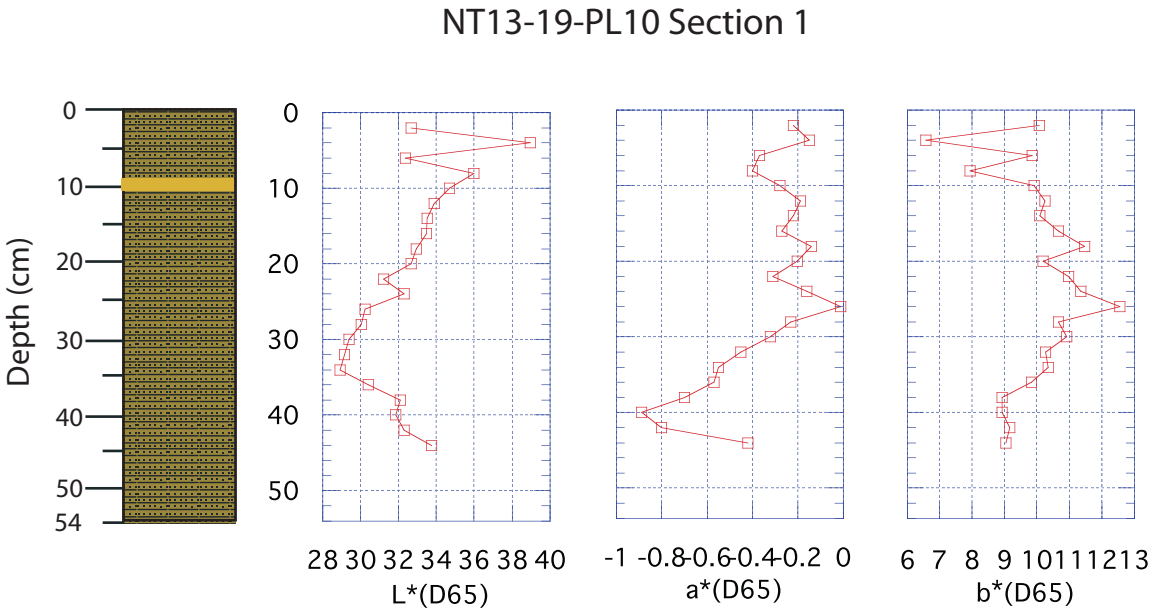


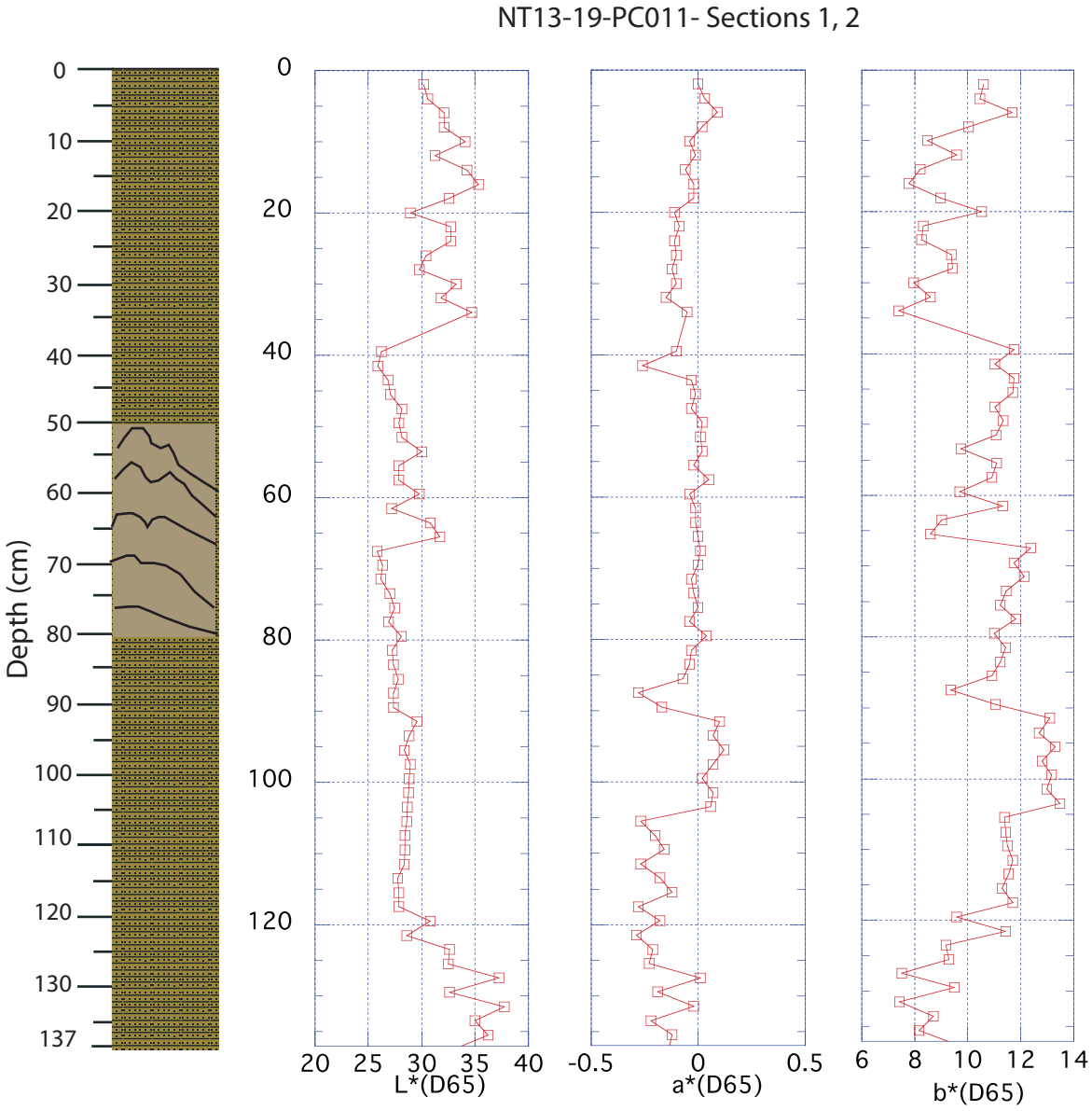
NT13-19-PC013- Sections 1, 2, 3



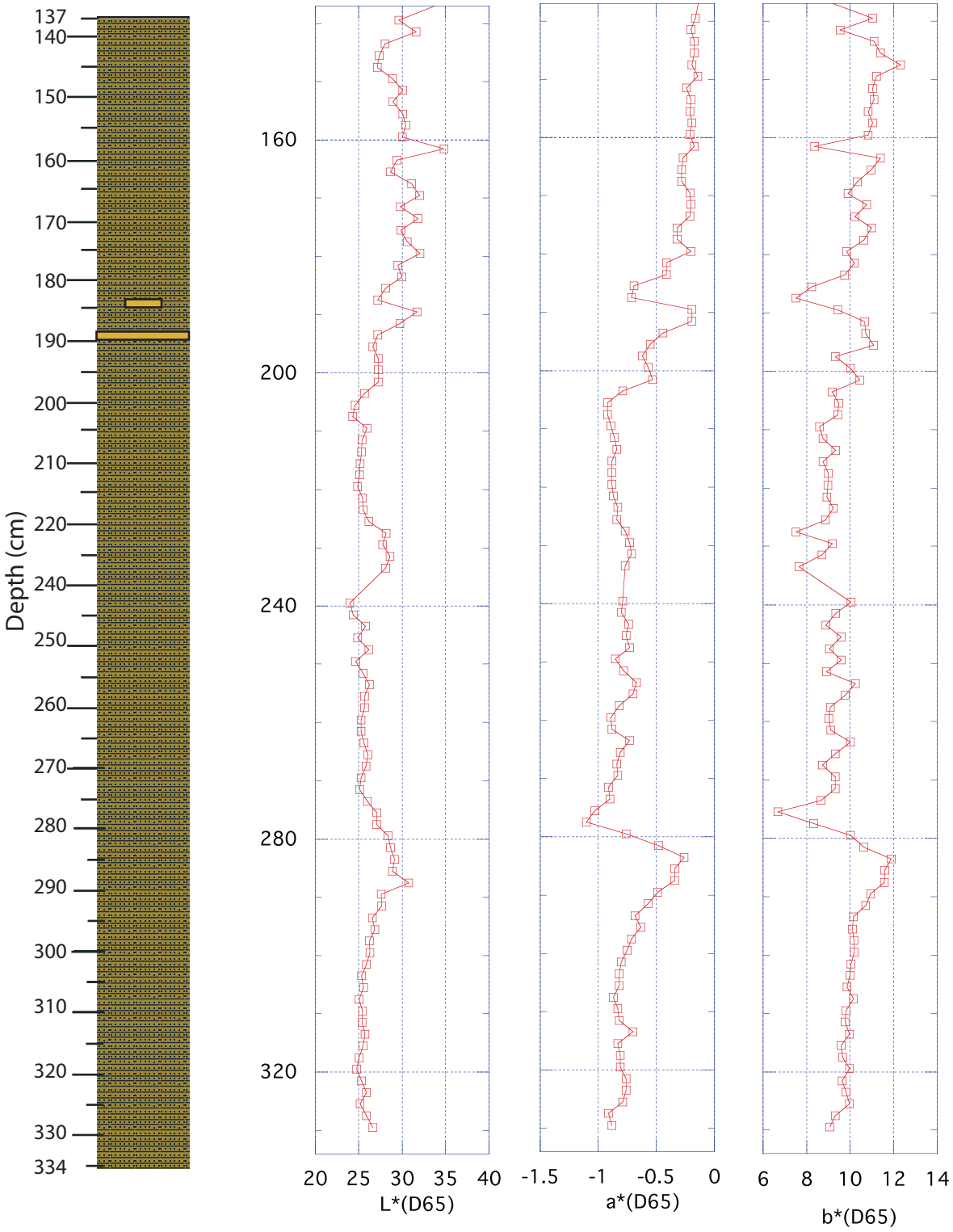
NT13-19-PC010- Sections 4, 5



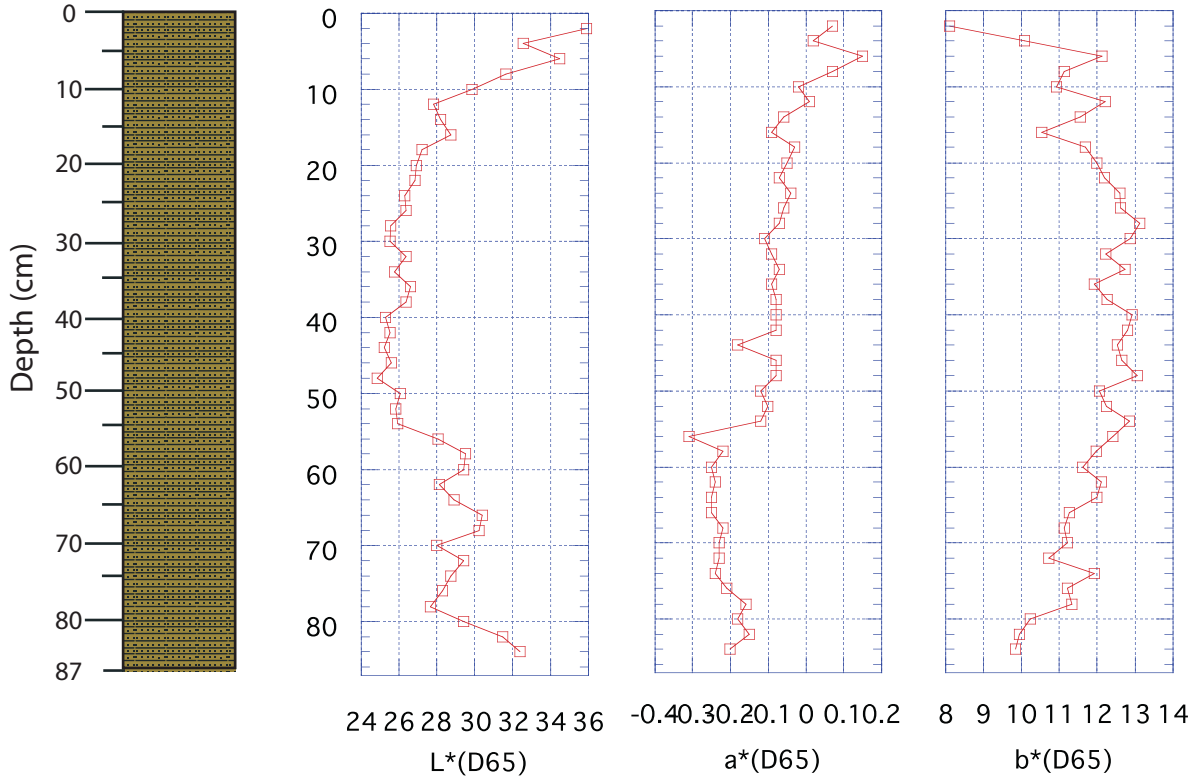

NT13-19-PL10 Section 1
Depth (cm)
0
10
20
30
40
50
54
28 30 32 34 36 38 40
L*(D65)
-1 -0.8-0.6-0.4-0.2 0
a*(D65)
6 7 8 9 10111213
b*(D65)


NT13-19-PC011- Sections 1, 2
Depth (cm)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
137
0
20
40
60
80
100
120
20
25
30
35
40
L*(D65)
-0.5
0
0.5
a*(D65)
6
8
10
12
14
b*(D65)

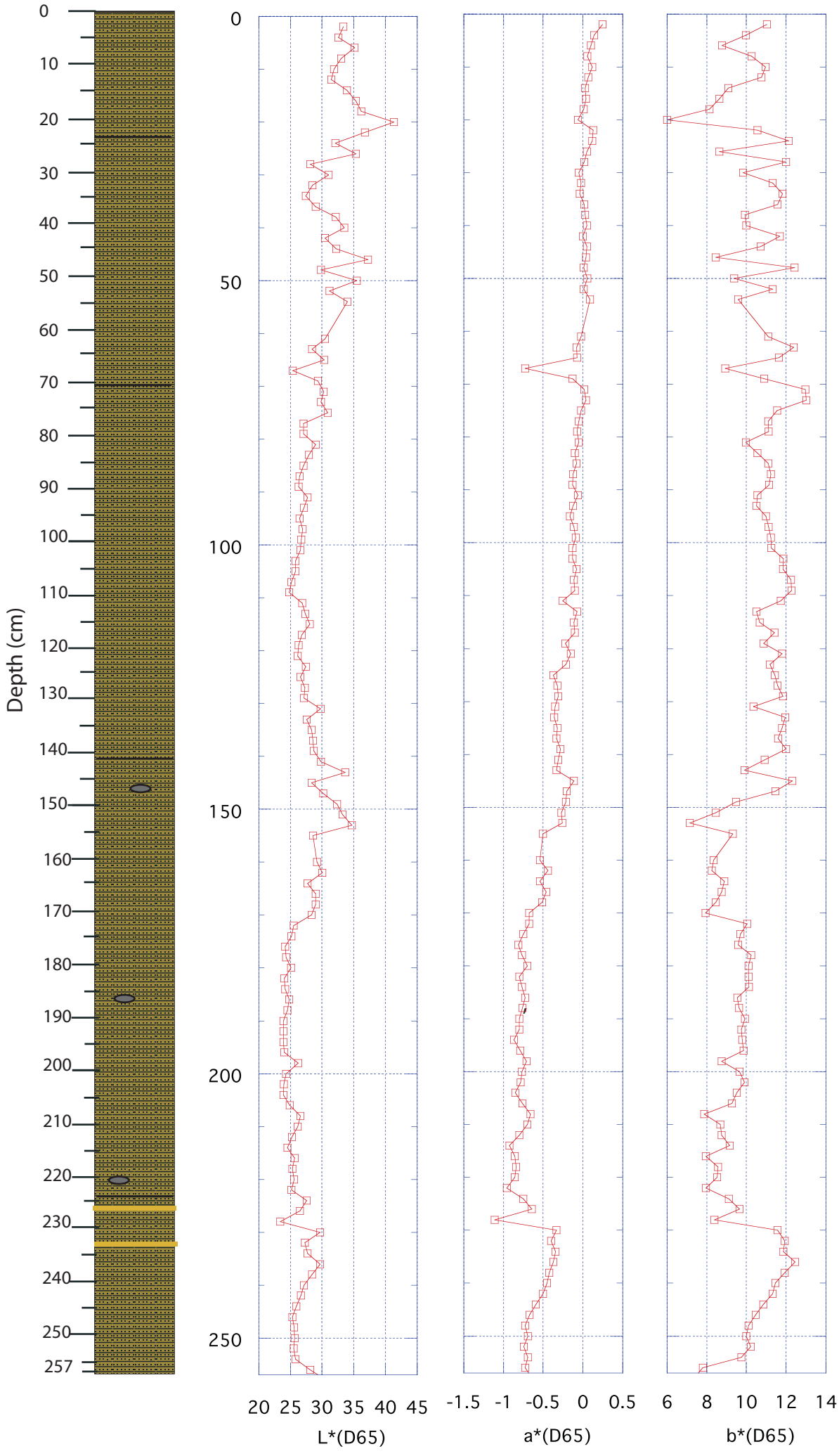
NT13-19-PC011- Sections 3, 4



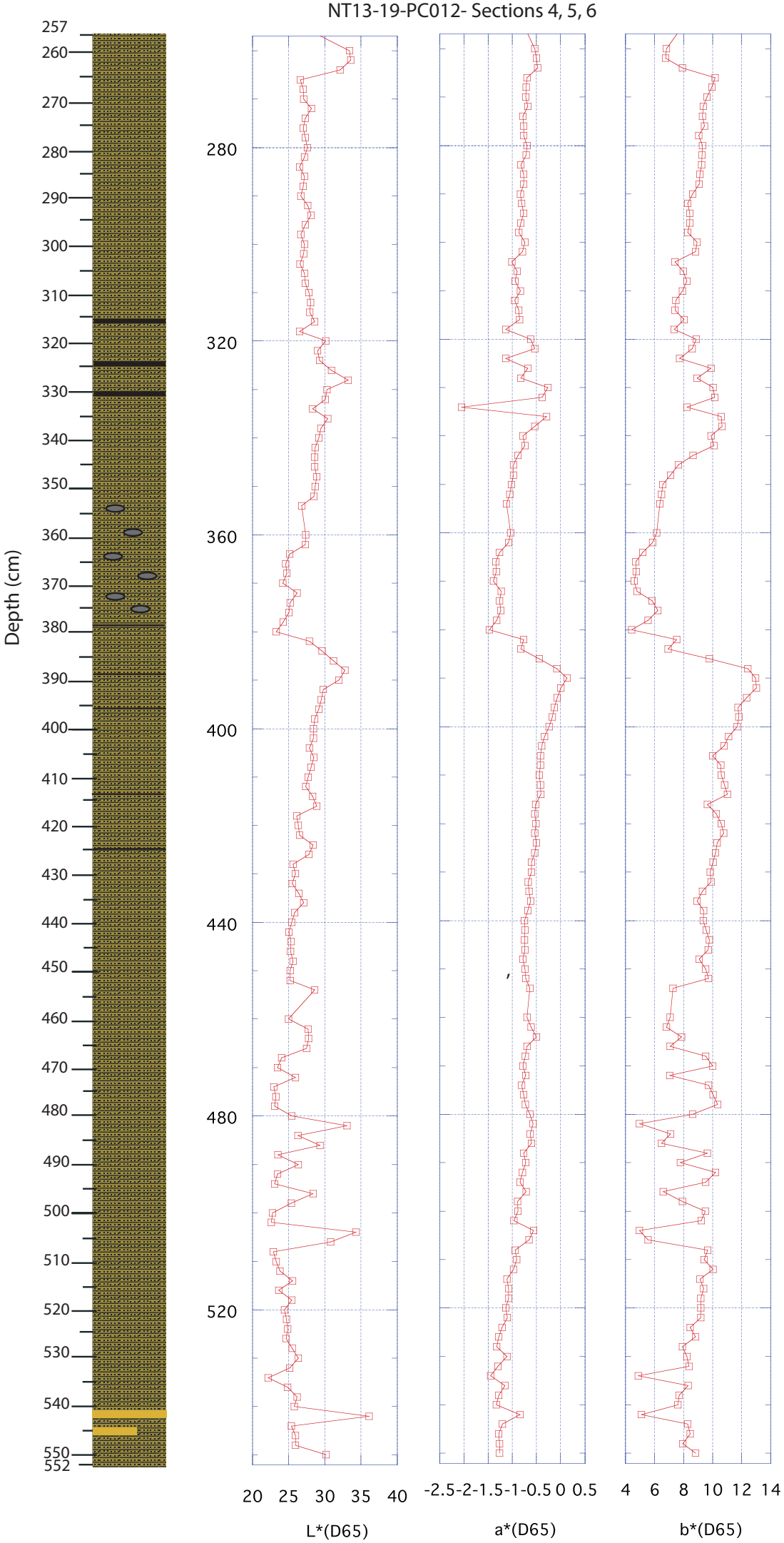
NT13-19-PL11 Sections 1



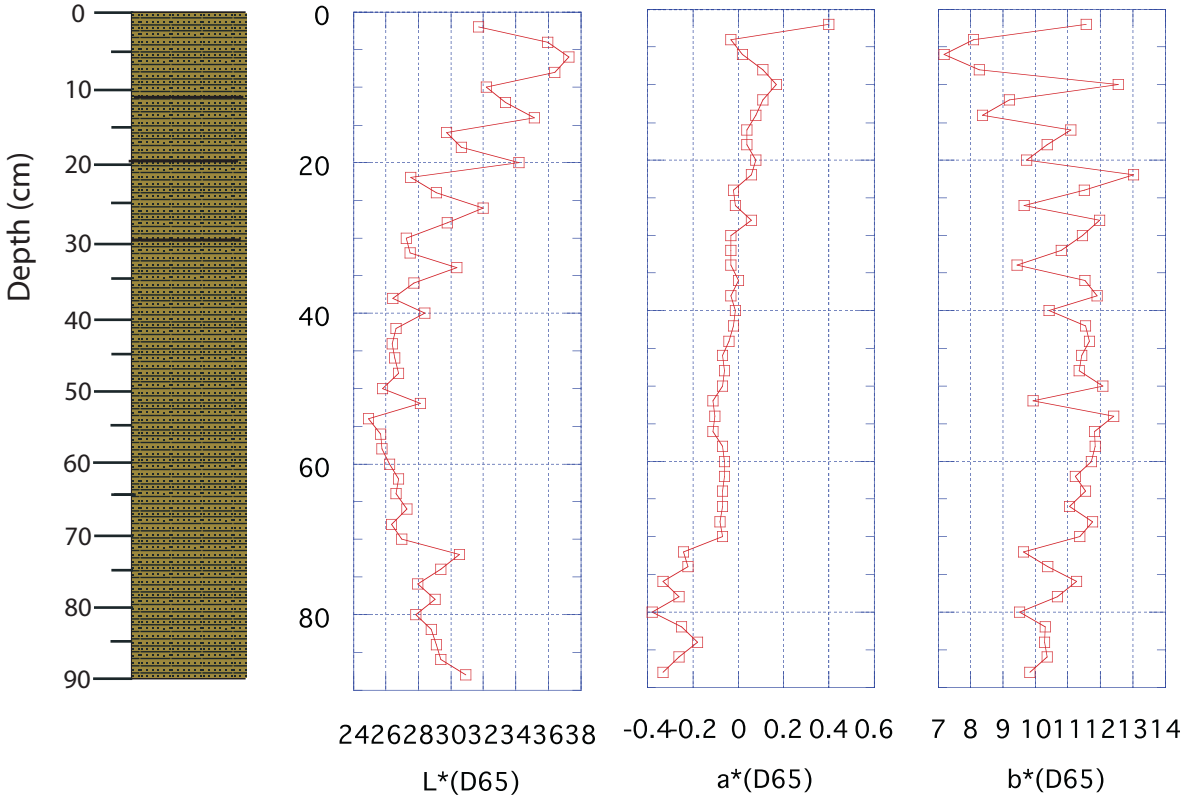
NT13-19-PC012- Sections 1, 2, 3



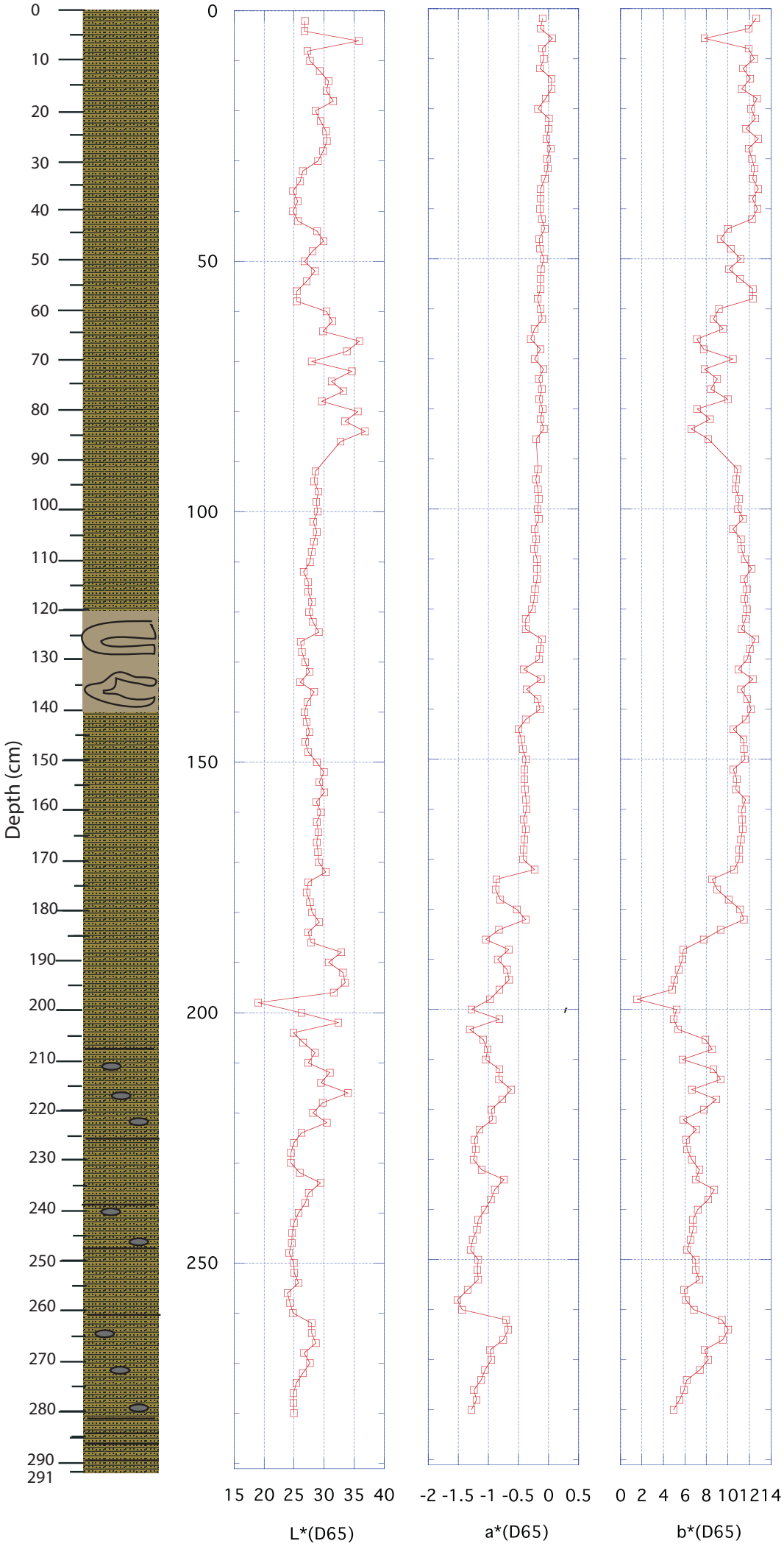
NT13-19-PC012- Sections 4, 5, 6



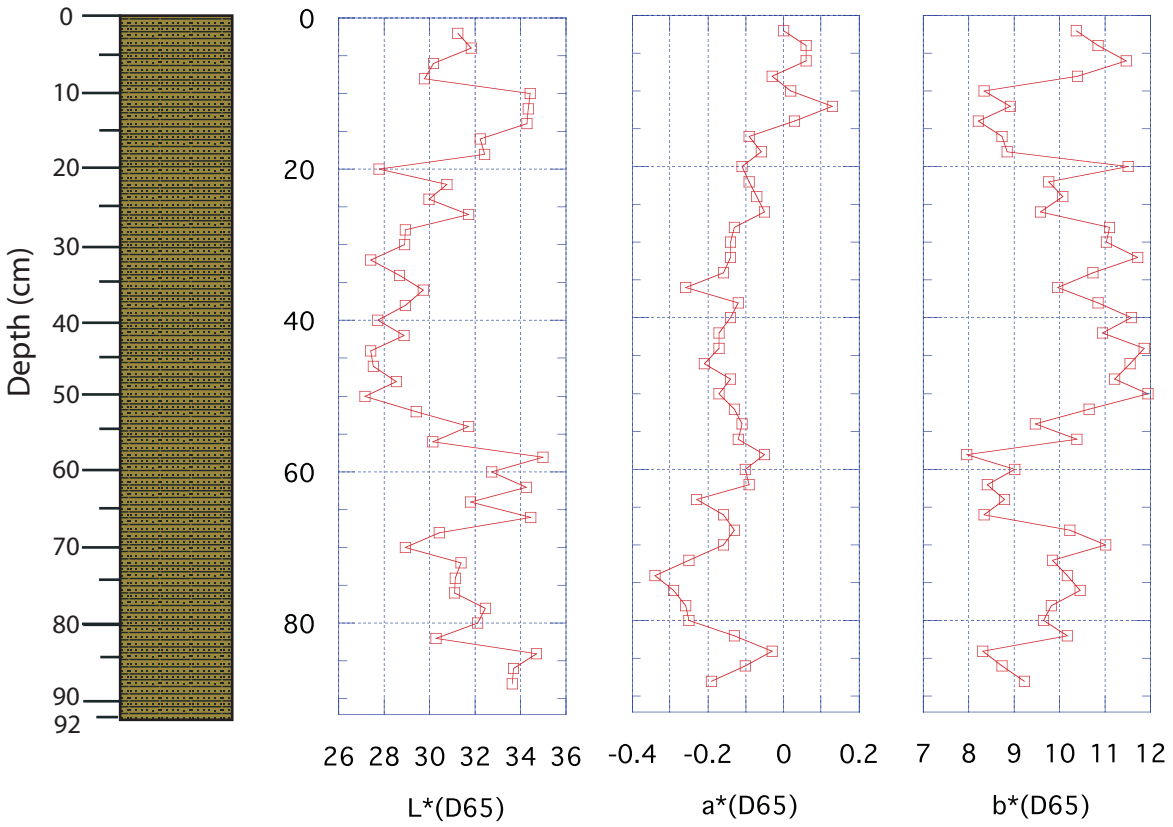
NT13-19-PL12 Section 1



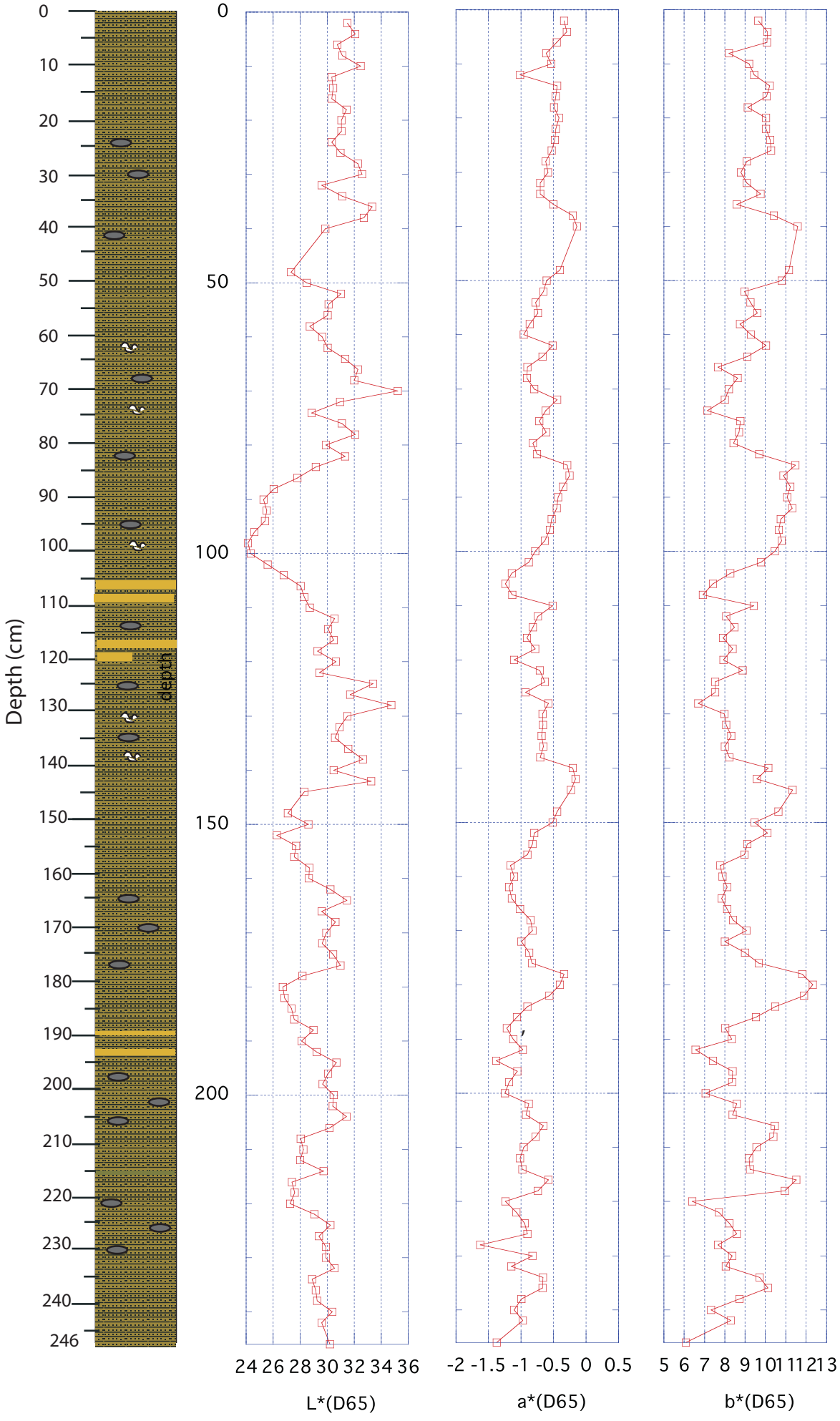
NT13-19-PC013- Sections 1, 2, 3



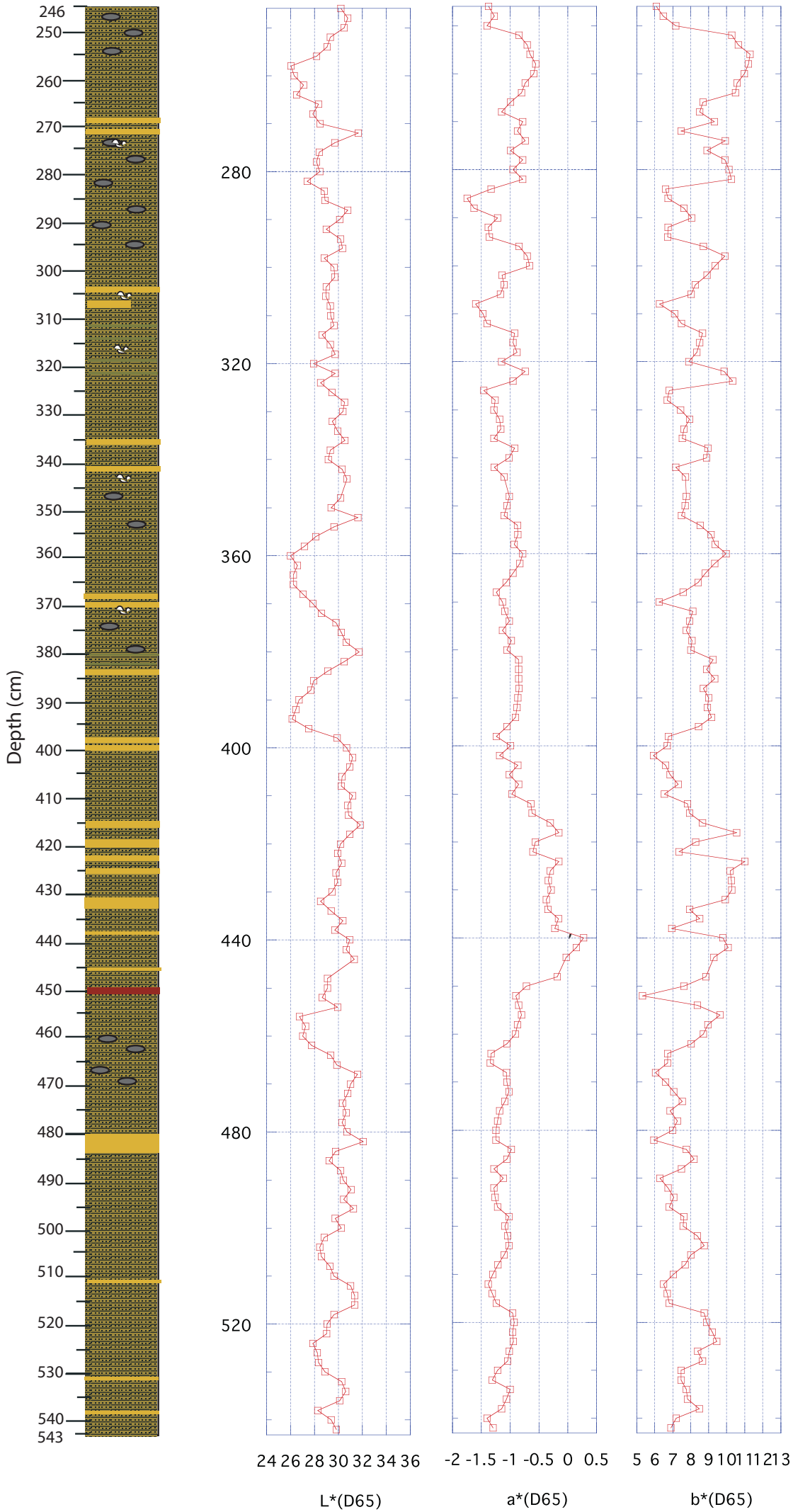
NT13-19-PL13 Section 1



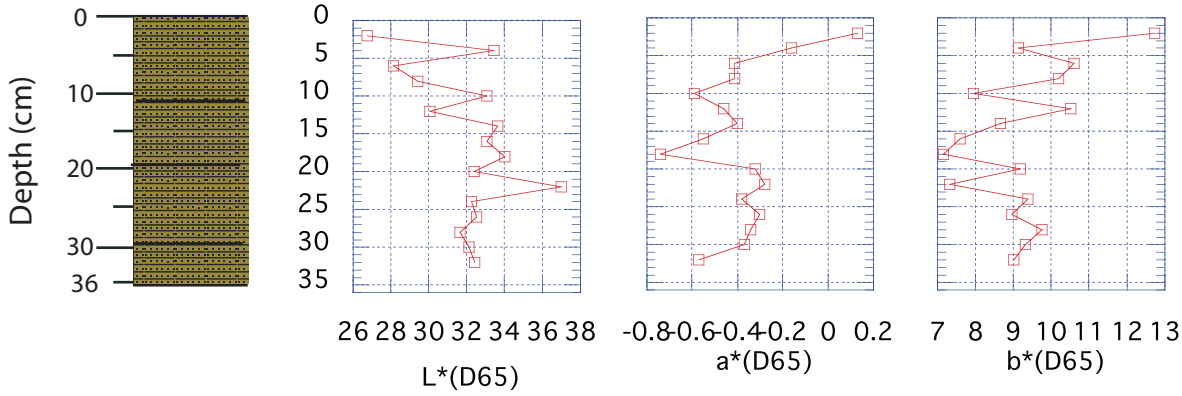
NT13-19-PC14- Sections 1, 2, 3



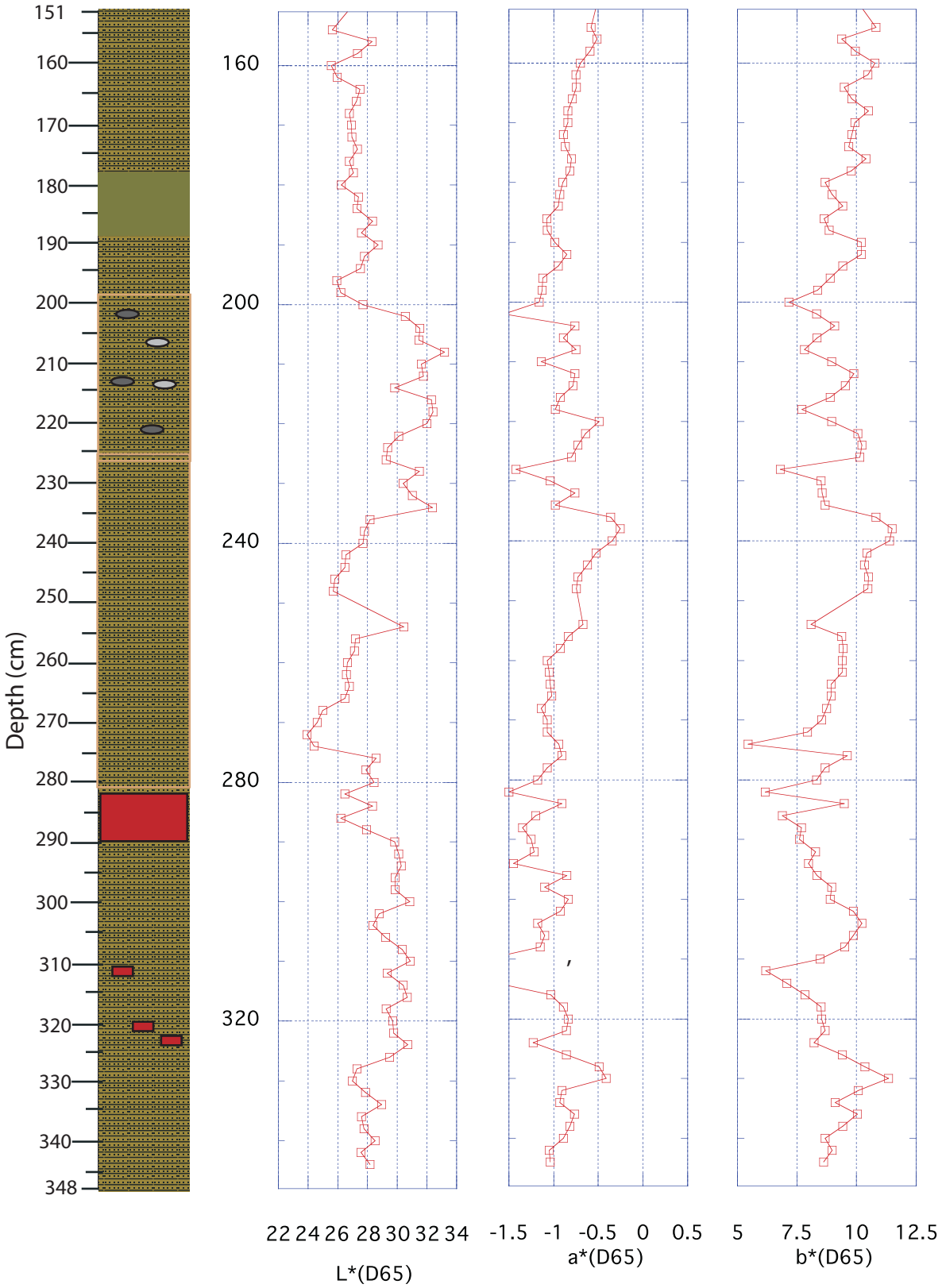
NT13-19-PC014 Sections 4, 5, 6



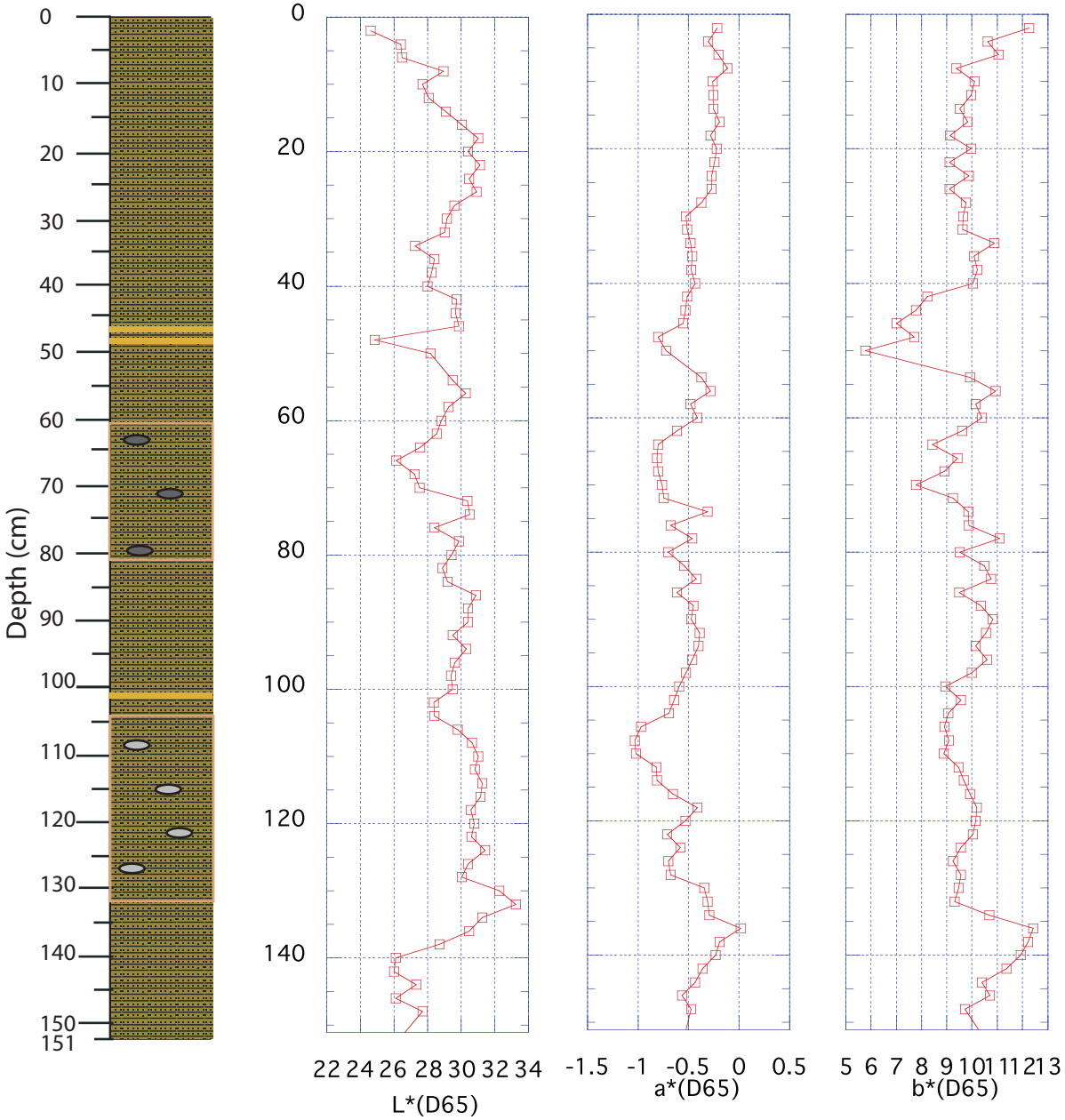
NT13-19-PL14Section 1



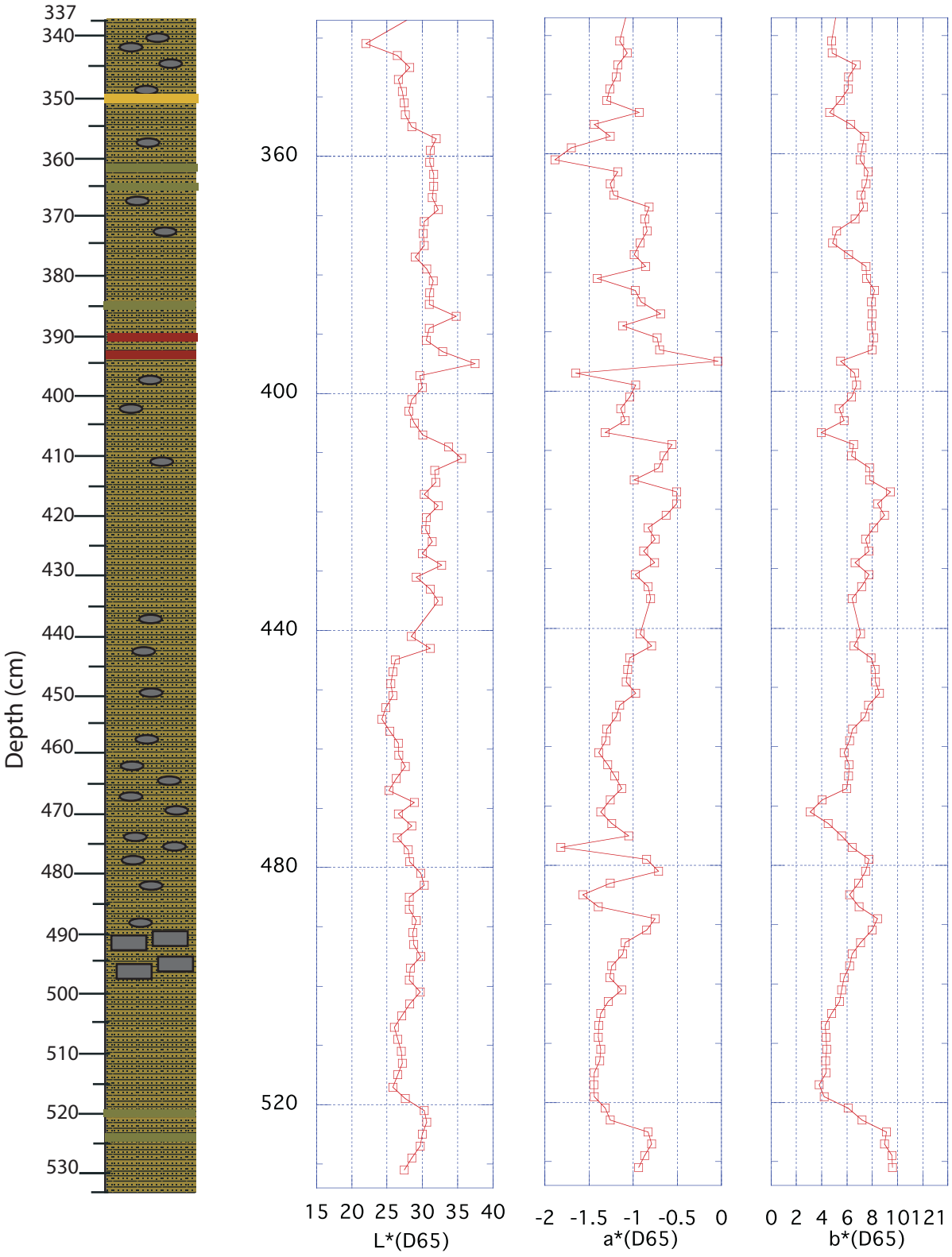
NT13-19-PC015- Sections 1, 2



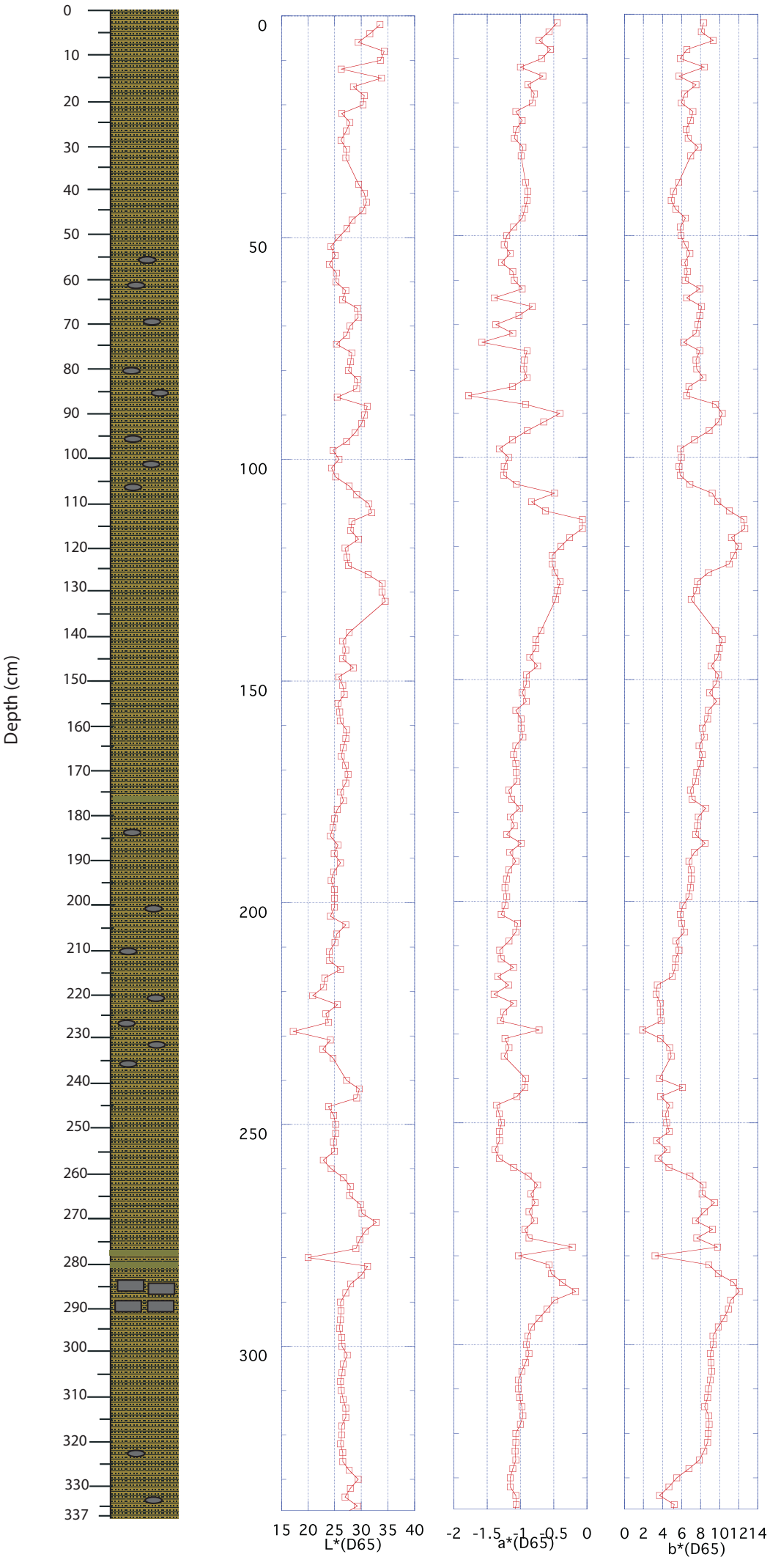
NT13-19-PC015- Sections 1, 2



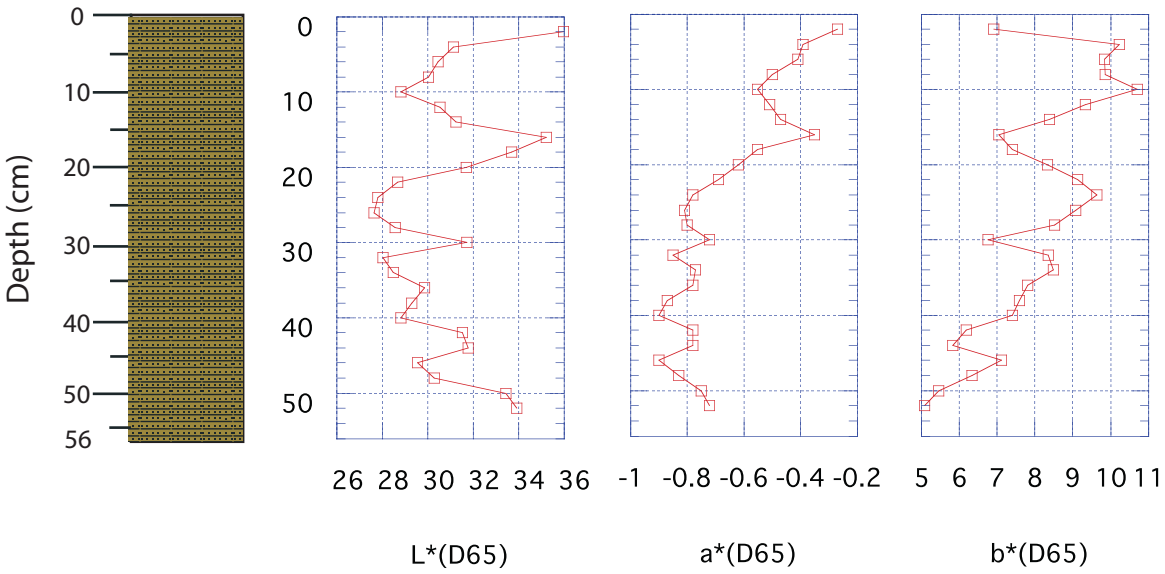
NT13-19-PC16- Sections 5, 6



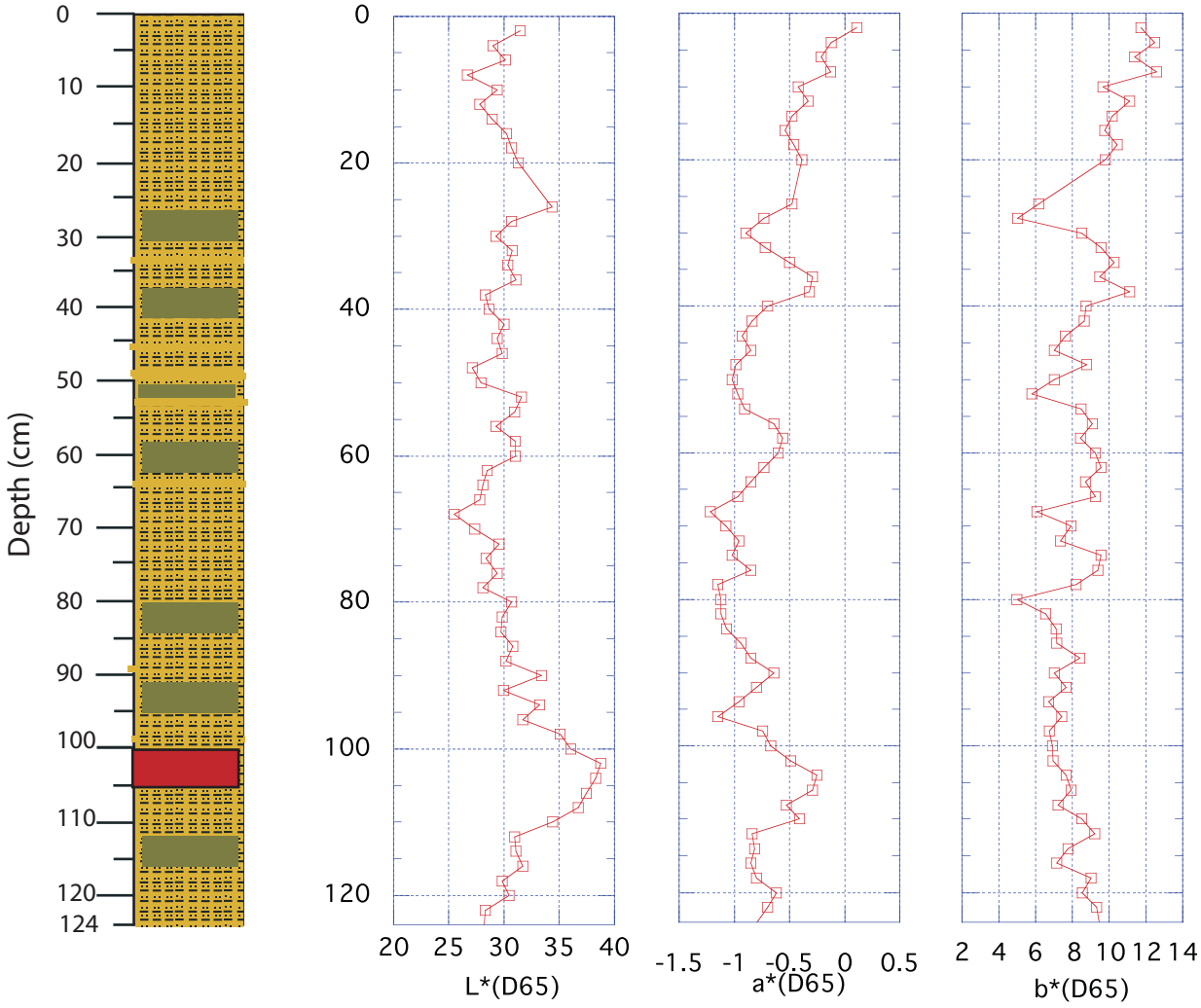
NT13-19-PC16- Sections 1, 2, 3, 4



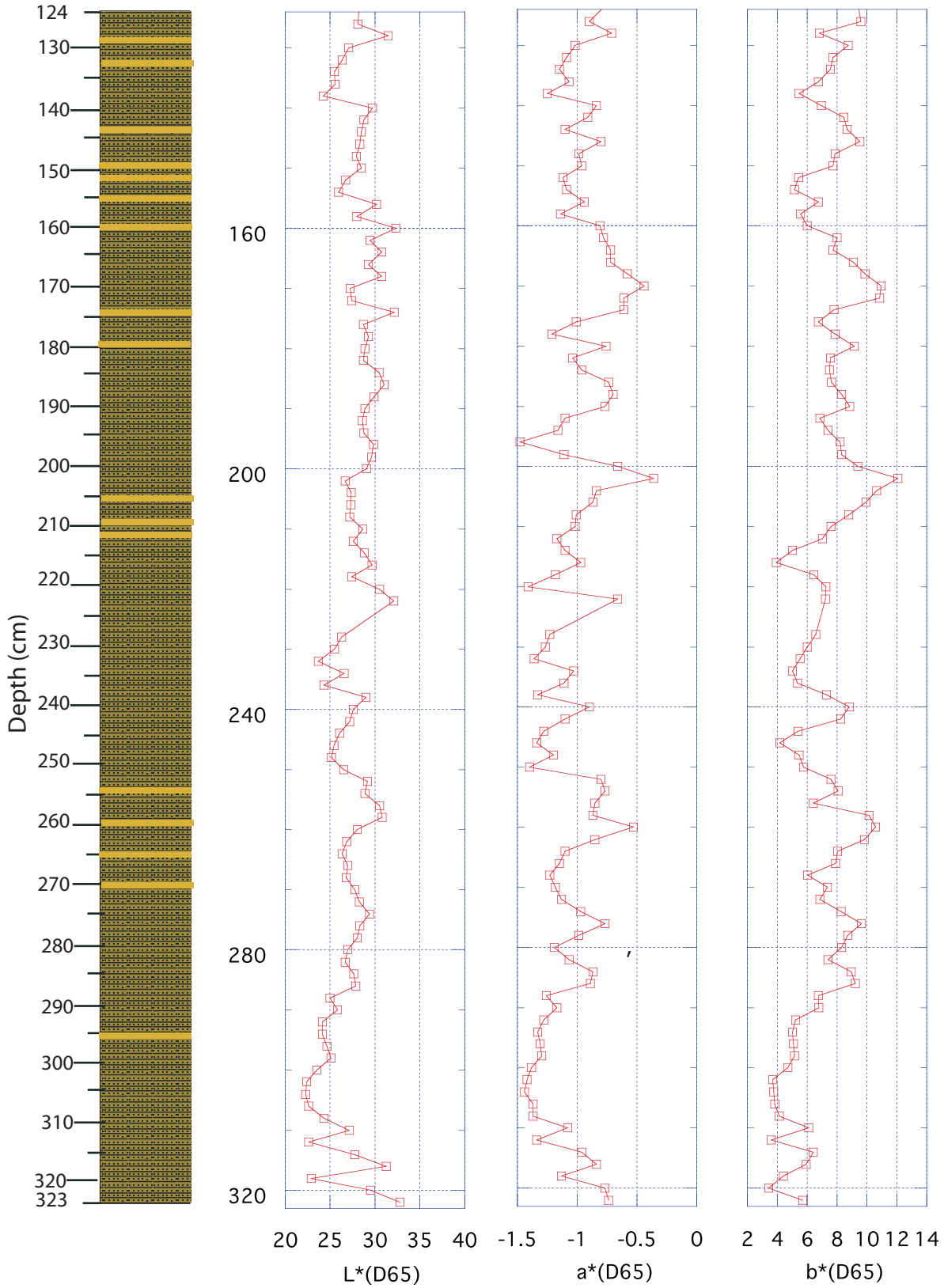
NT13-19-PL16 Section 1, CC



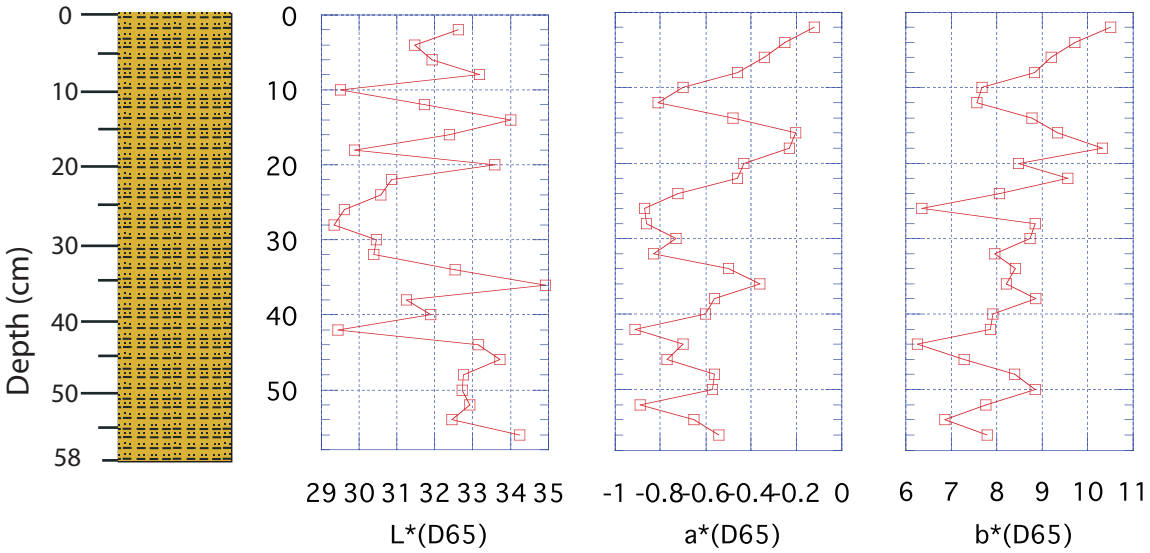
NT13-19-PC017- Sections 1, 2



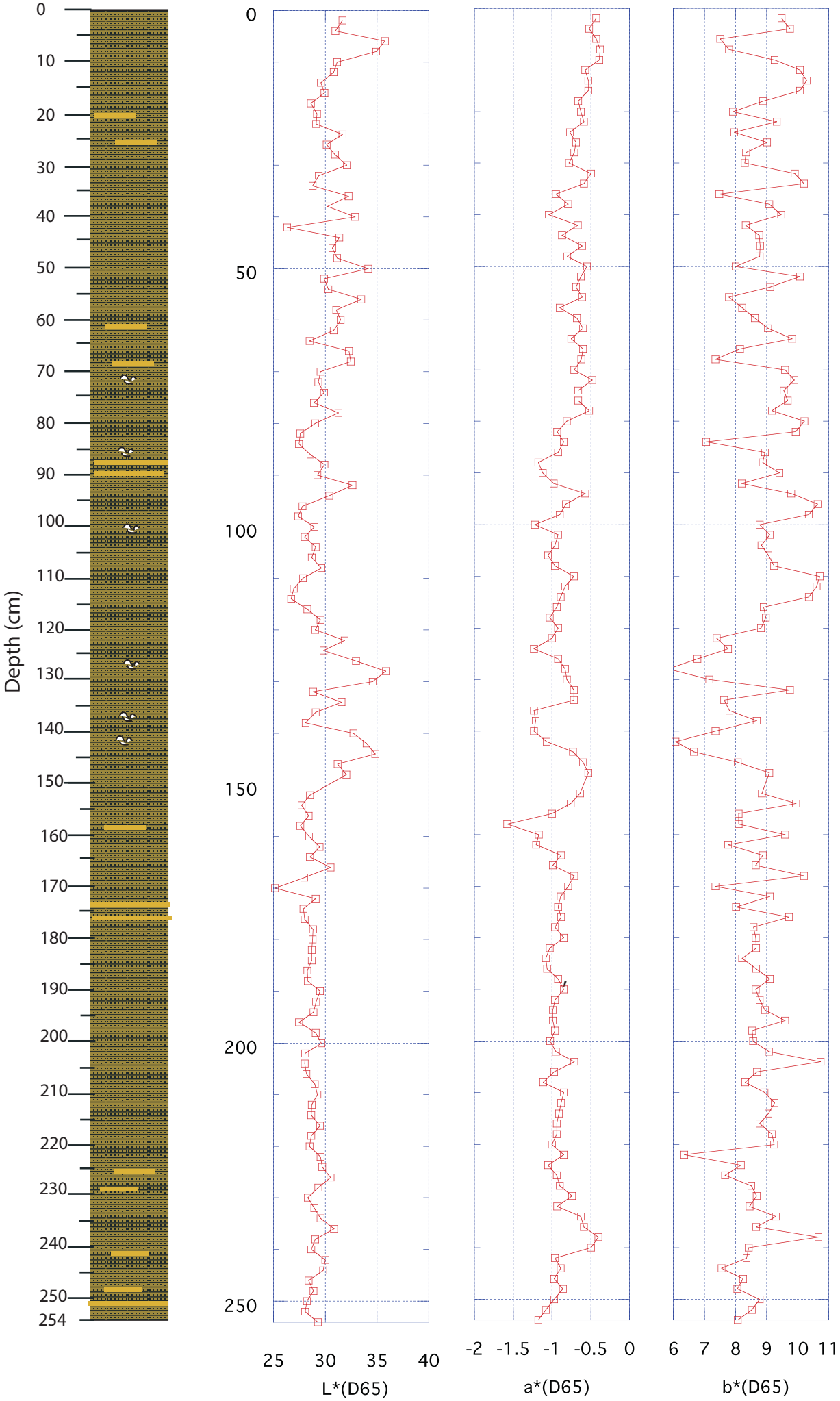
NT13-19-PC017- Sections 3, 4



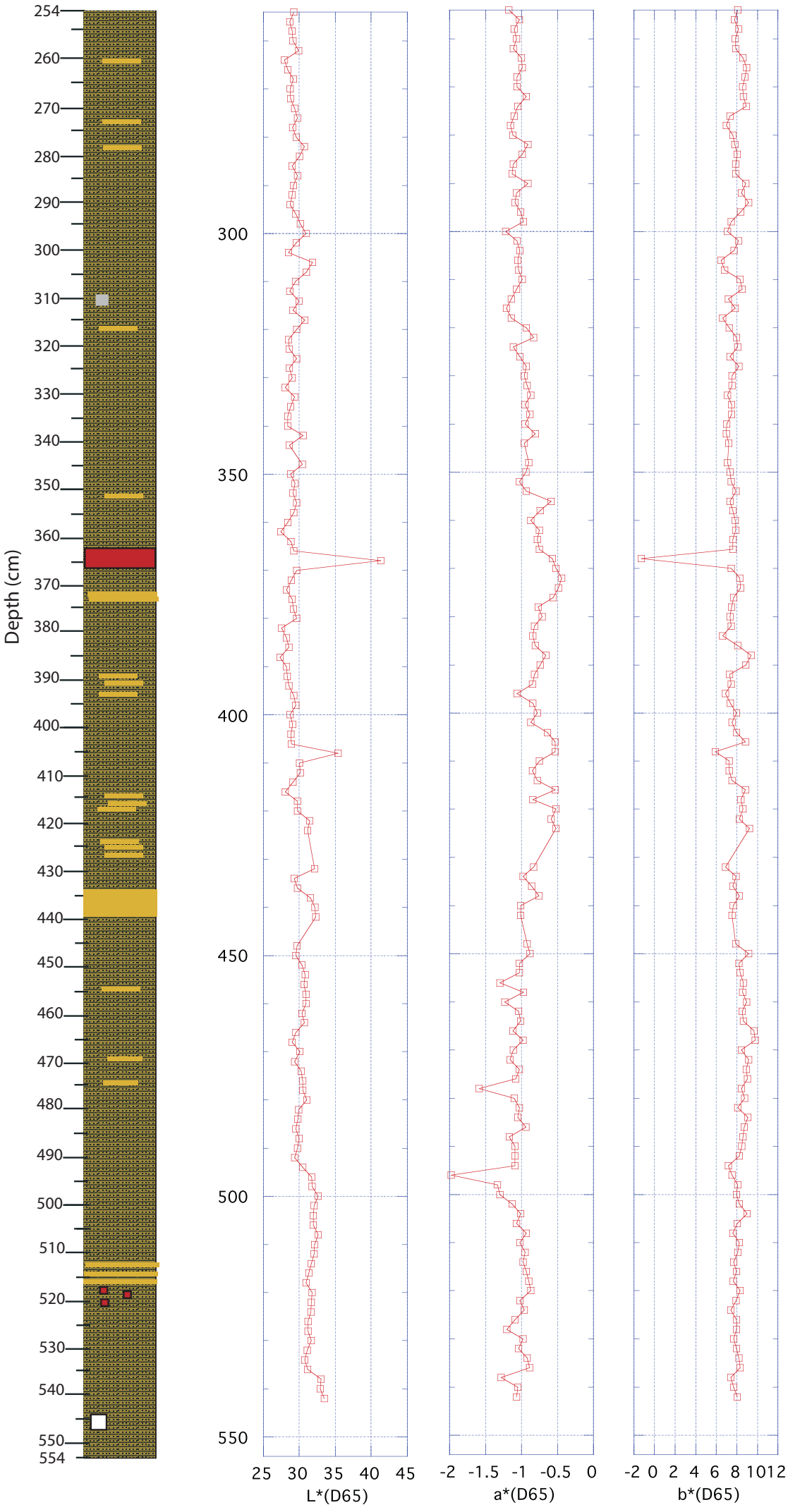
NT13-19-PL17 Section 1



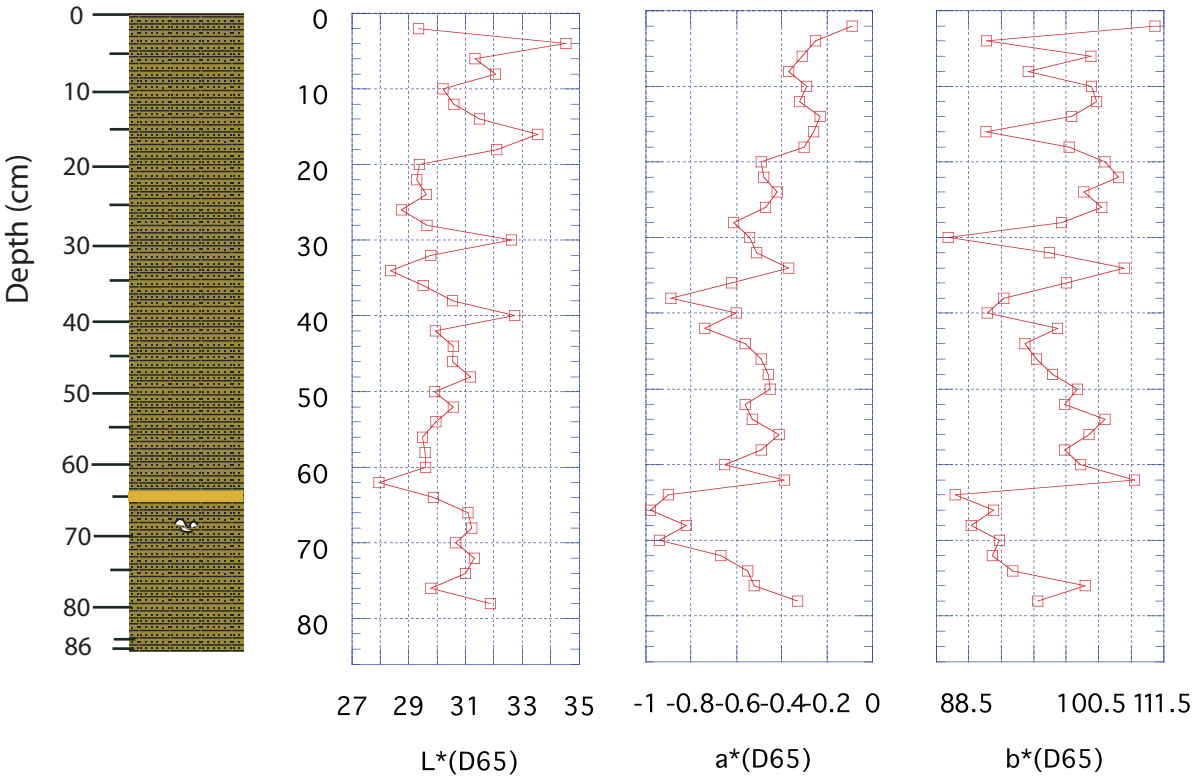
NT13-19-PC018- Sections 1, 2, 3



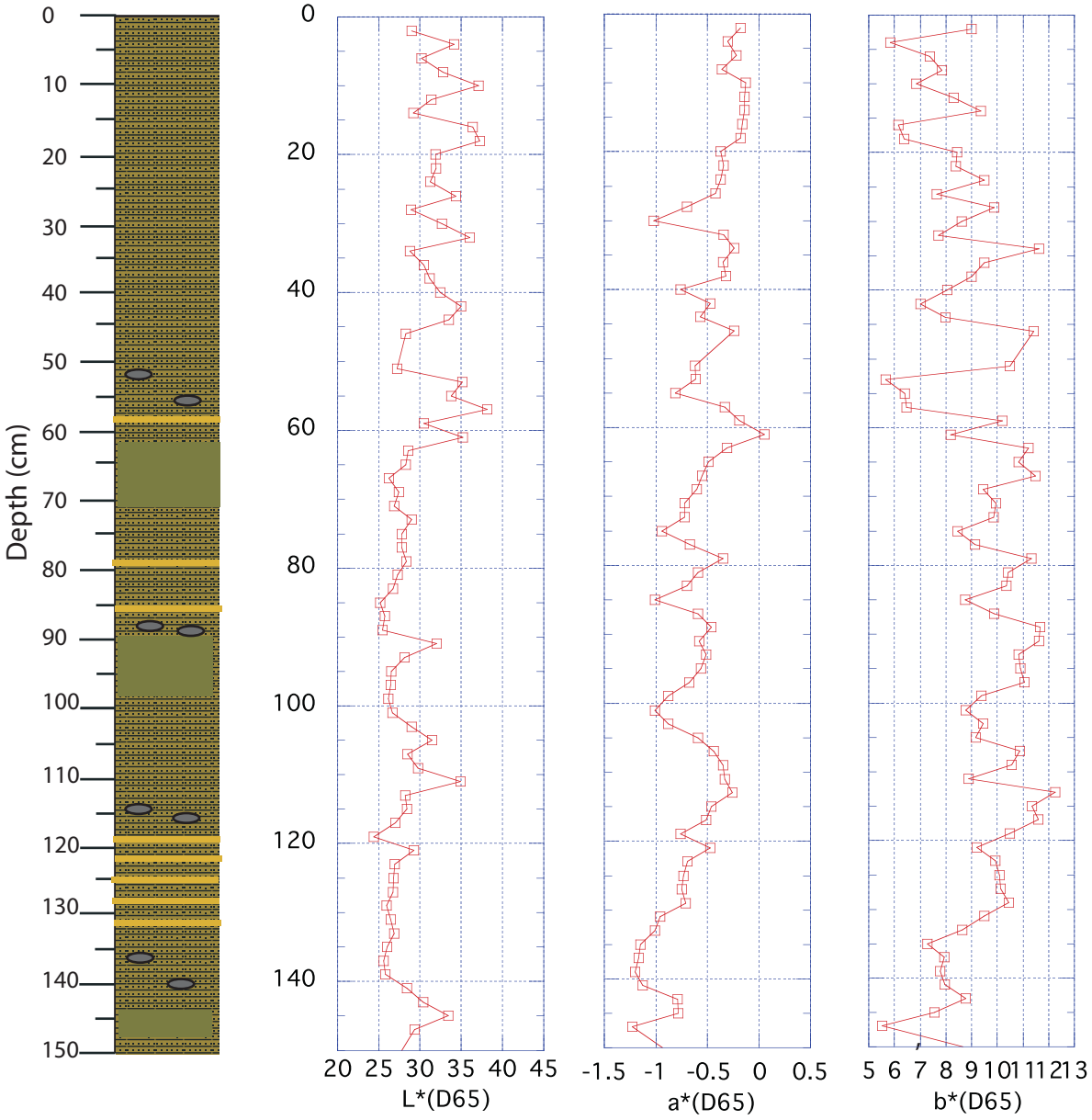
NT13-19-PC018- Sections 4, 5, 6



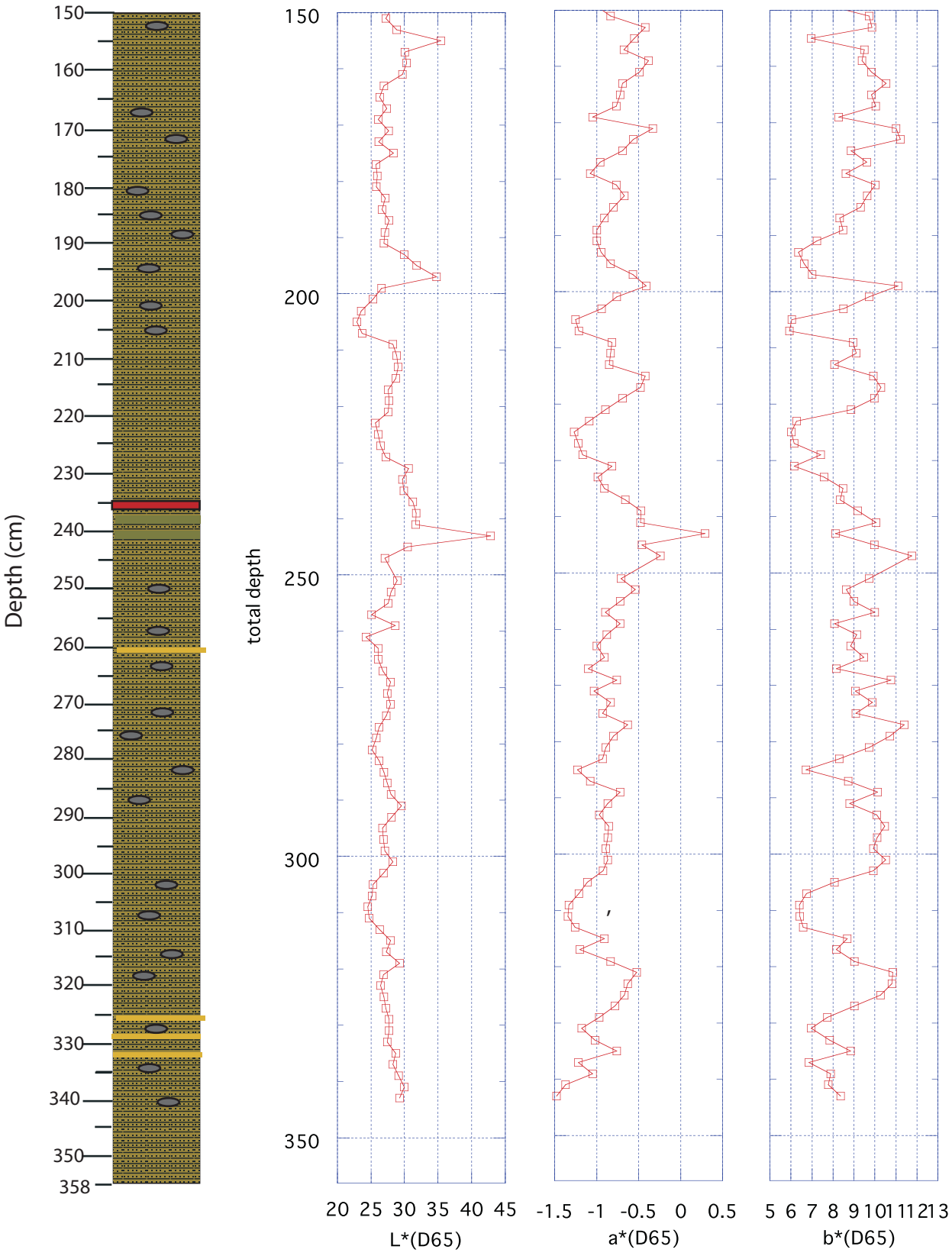
NT13-19-PL18 Section 1, CC



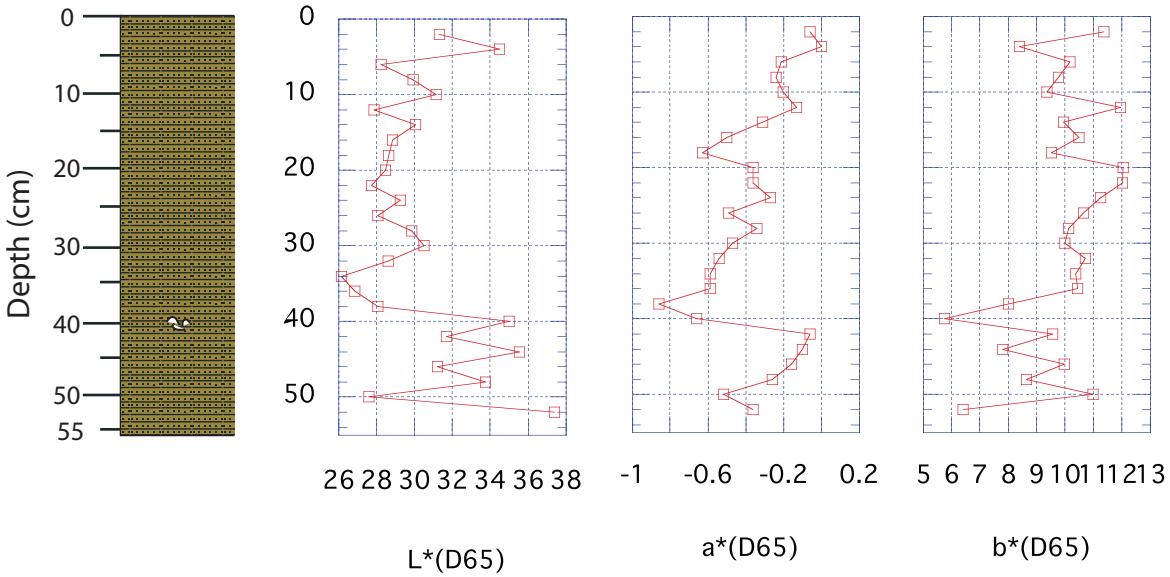
NT13-19-PC019- Sections 1, 2



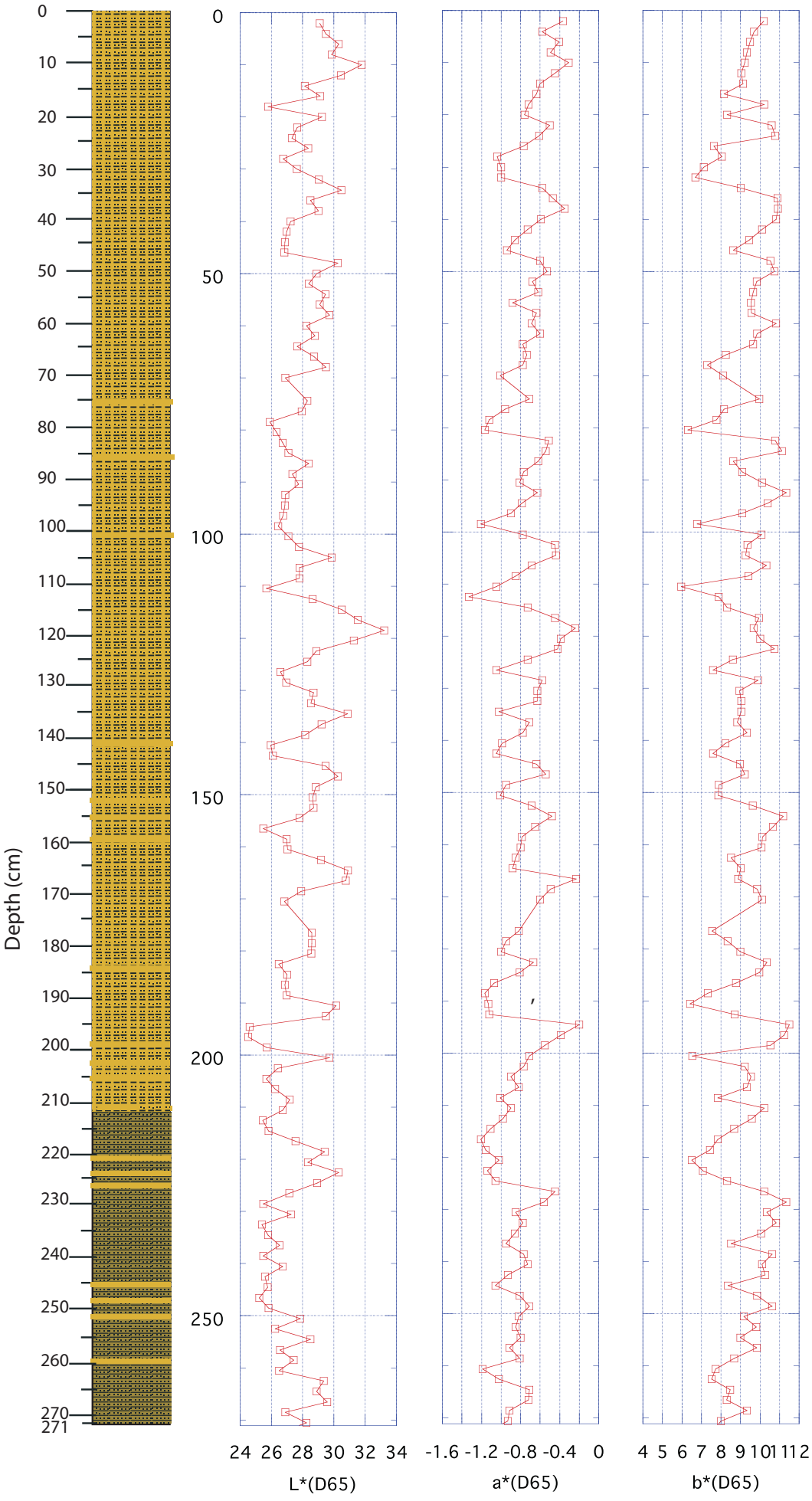
NT13-19-PC019- Sections 3-4

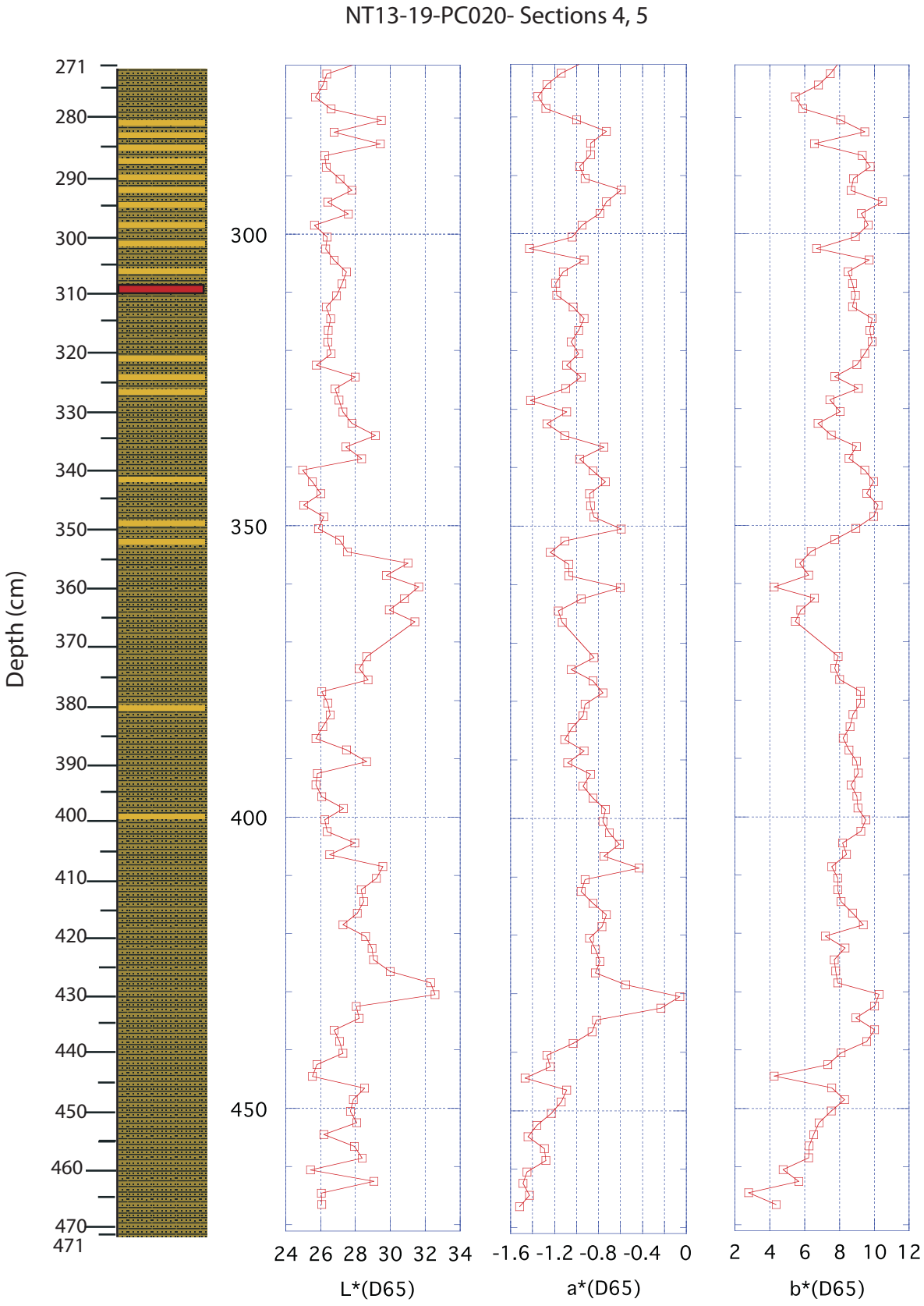


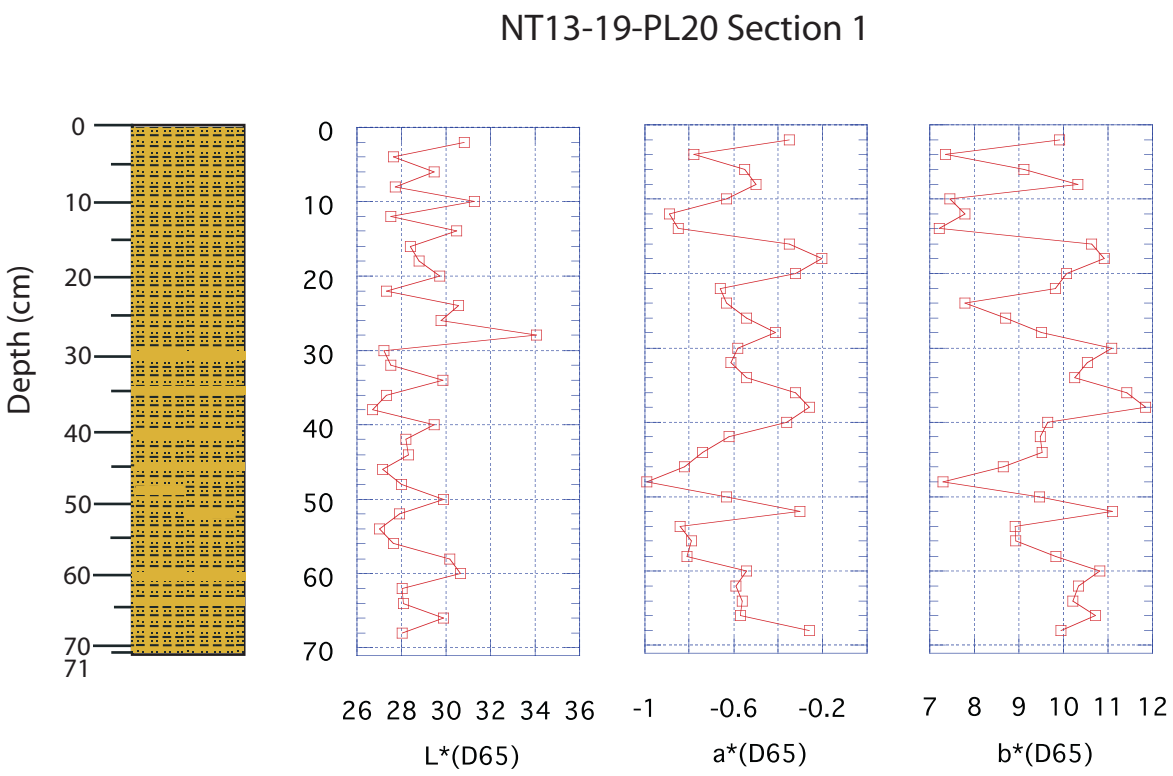
NT13-19-PL19 Section 1



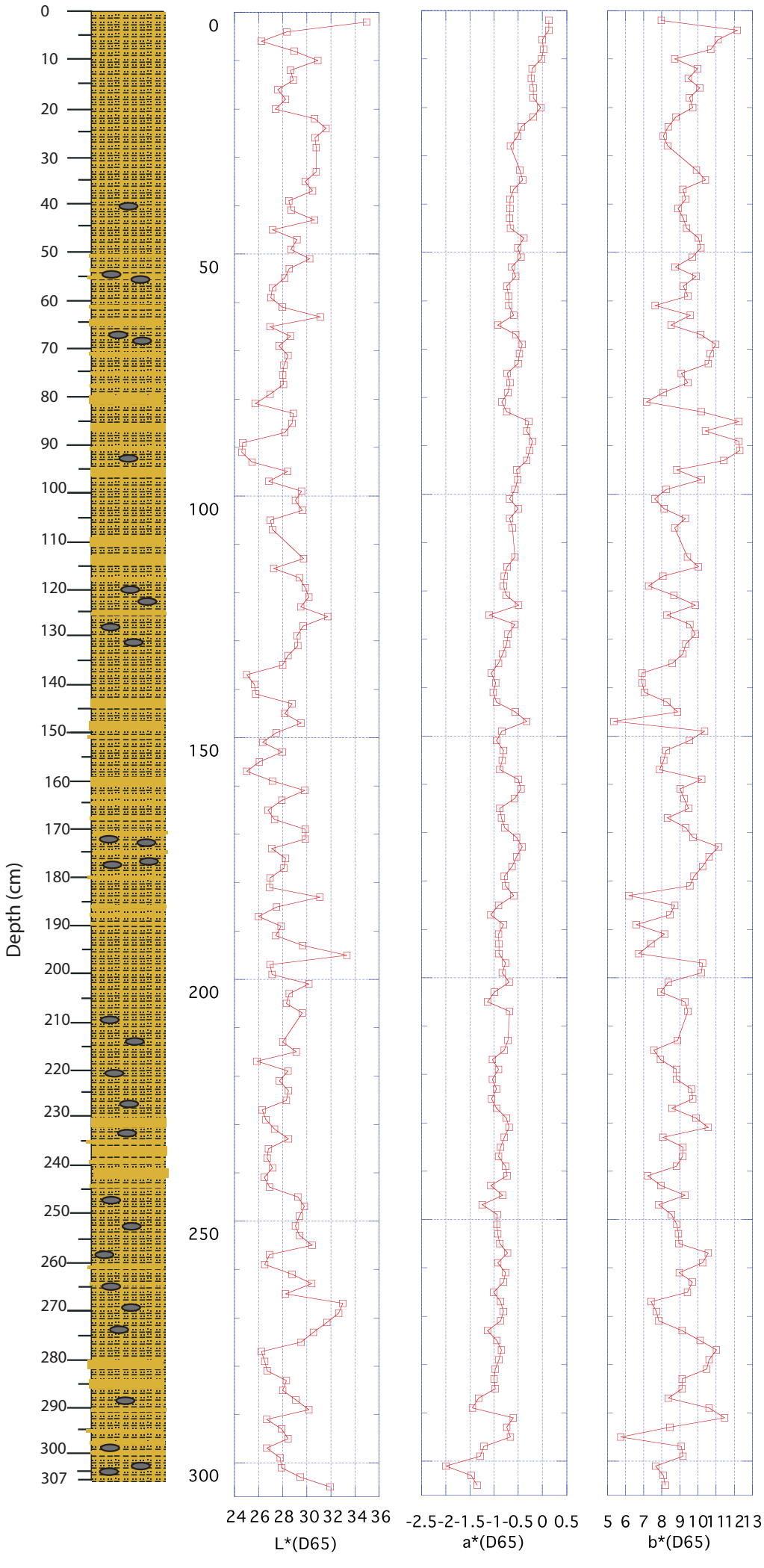
NT13-19-PC020- Sections 1, 2, 3



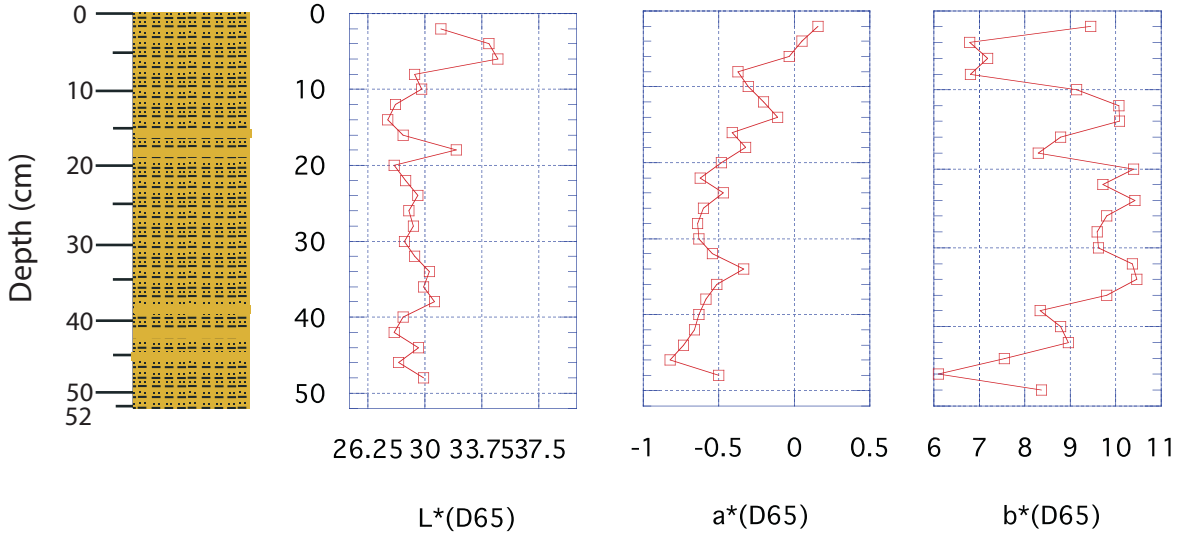

NT13-19-PC020- Sections 4, 5
Depth (cm)
271
280
290
300
310
320
330
340
350
360
370
380
390
400
410
420
430
440
450
460
470
471
300
350
400
450
24 26 28 30 32 34
L*(D65)
-1.6 -1.2 -0.8 -0.4 0
a*(D65)
2 4 6 8 10 12
b*(D65)


NT13-19-PL20 Section 1
Depth (cm)
0
10
20
30
40
50
60
70
71
26 28 30 32 34 36
L*(D65)
-1 -0.6 -0.2
a*(D65)
7 8 9 10 11 12
b*(D65)

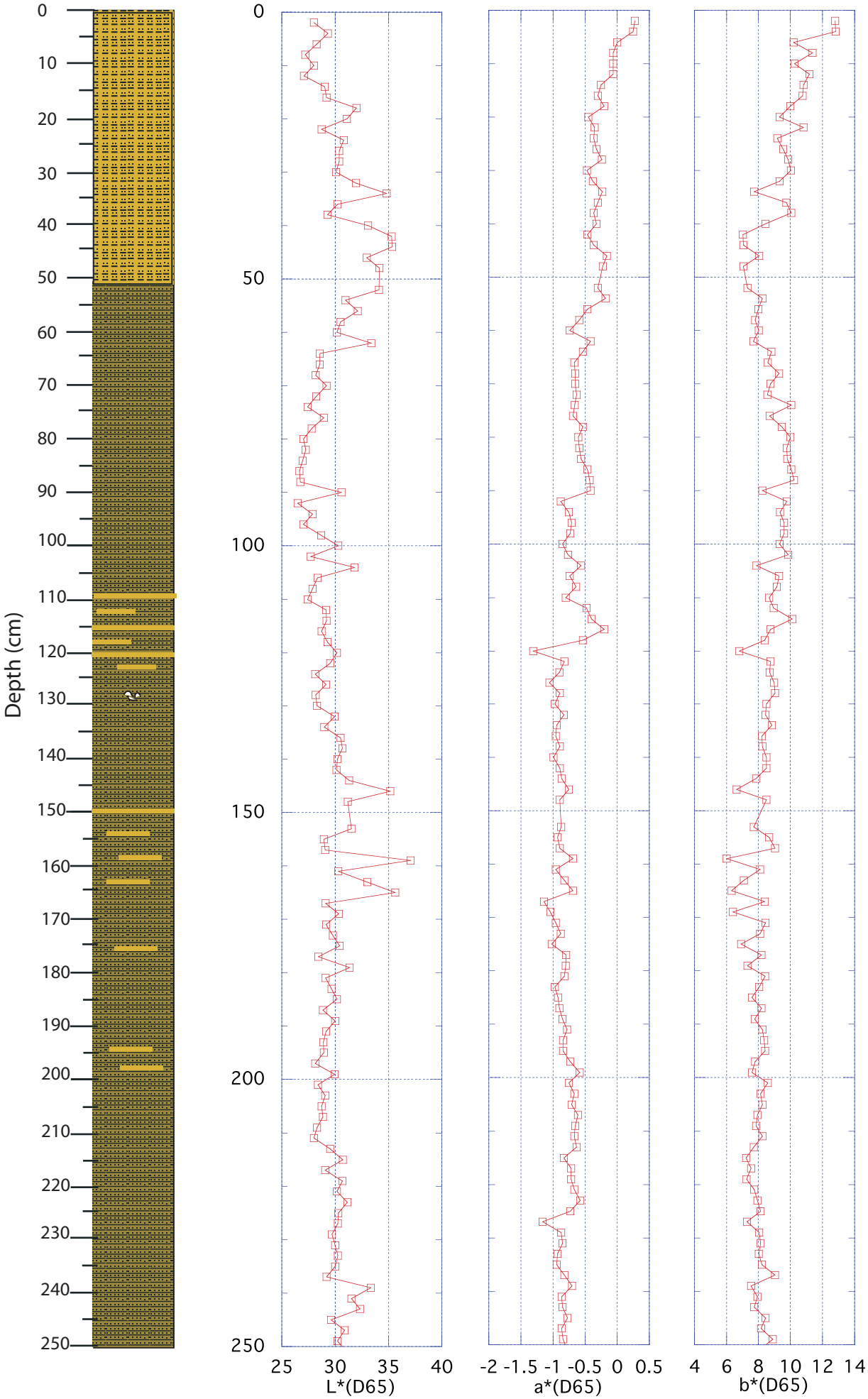
NT13-19-PC021- Sections 1, 2, 3, 4



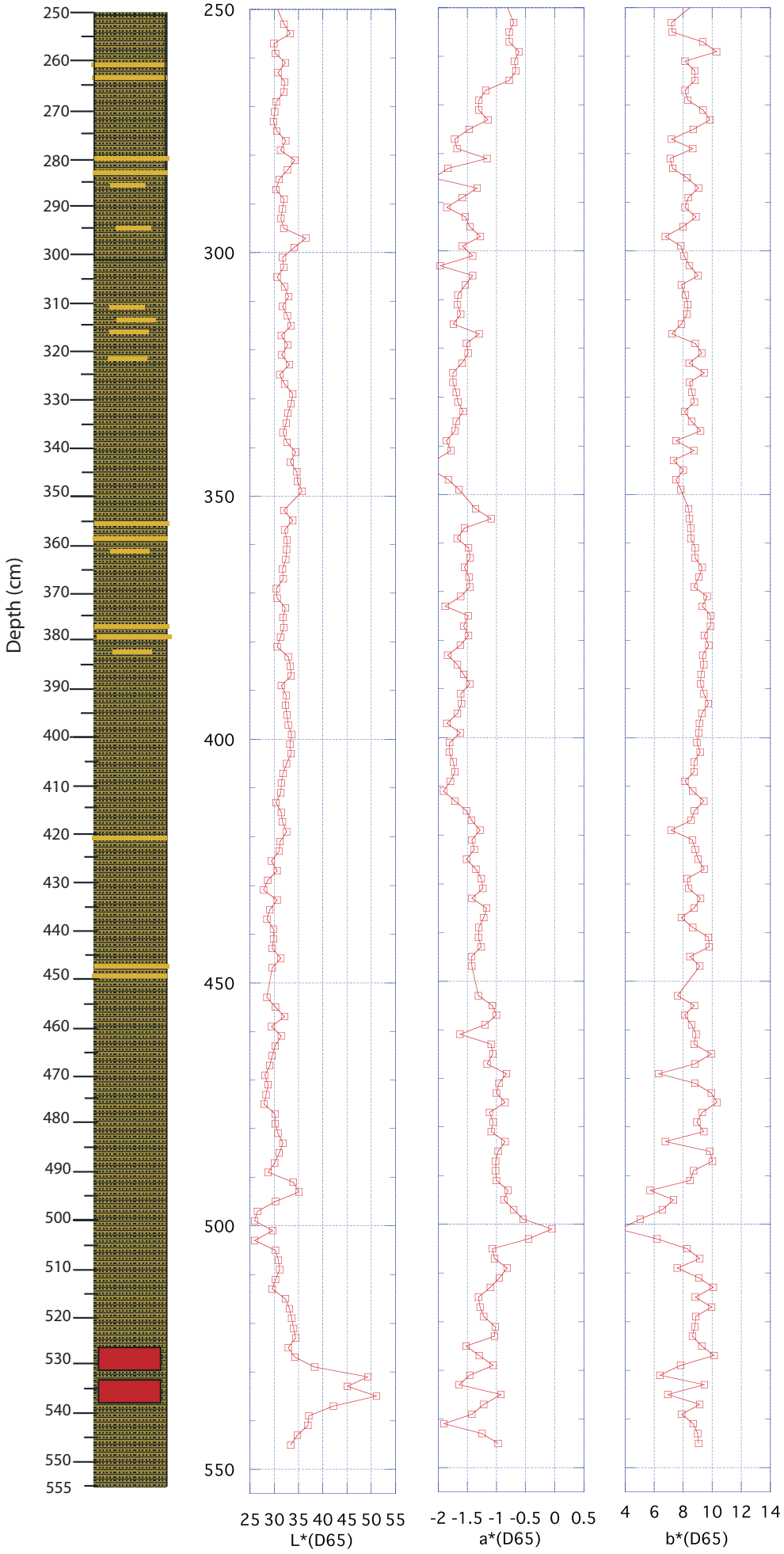
NT13-19-PL21 Section 1, CC



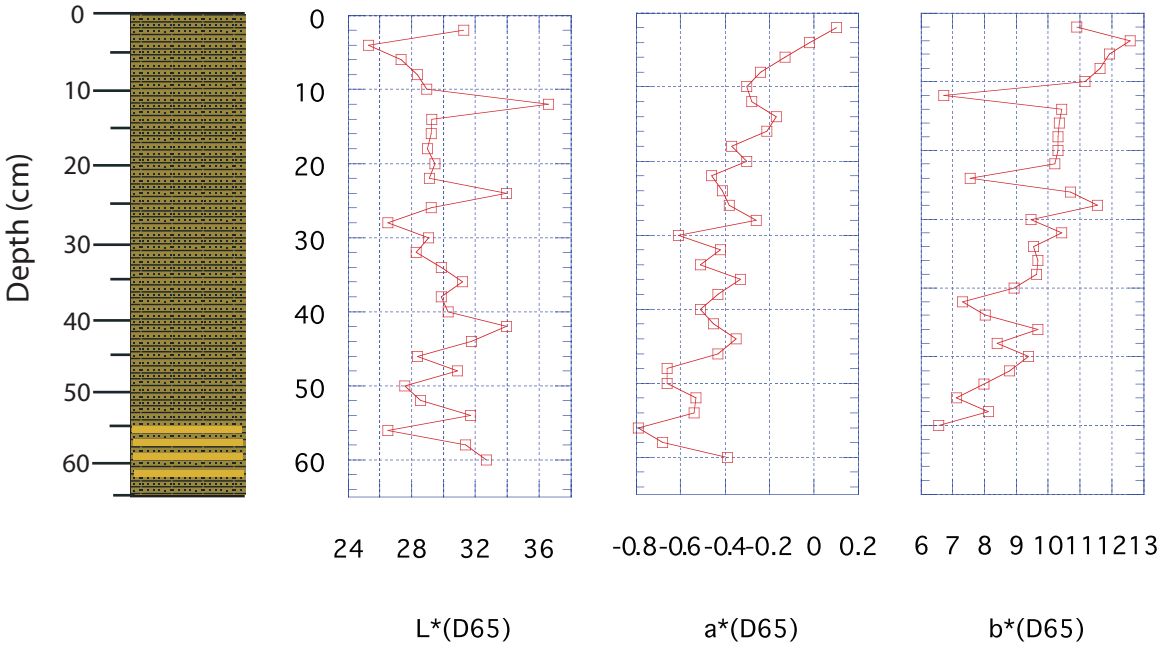
NT13-19-PC022- Sections 1.2.3



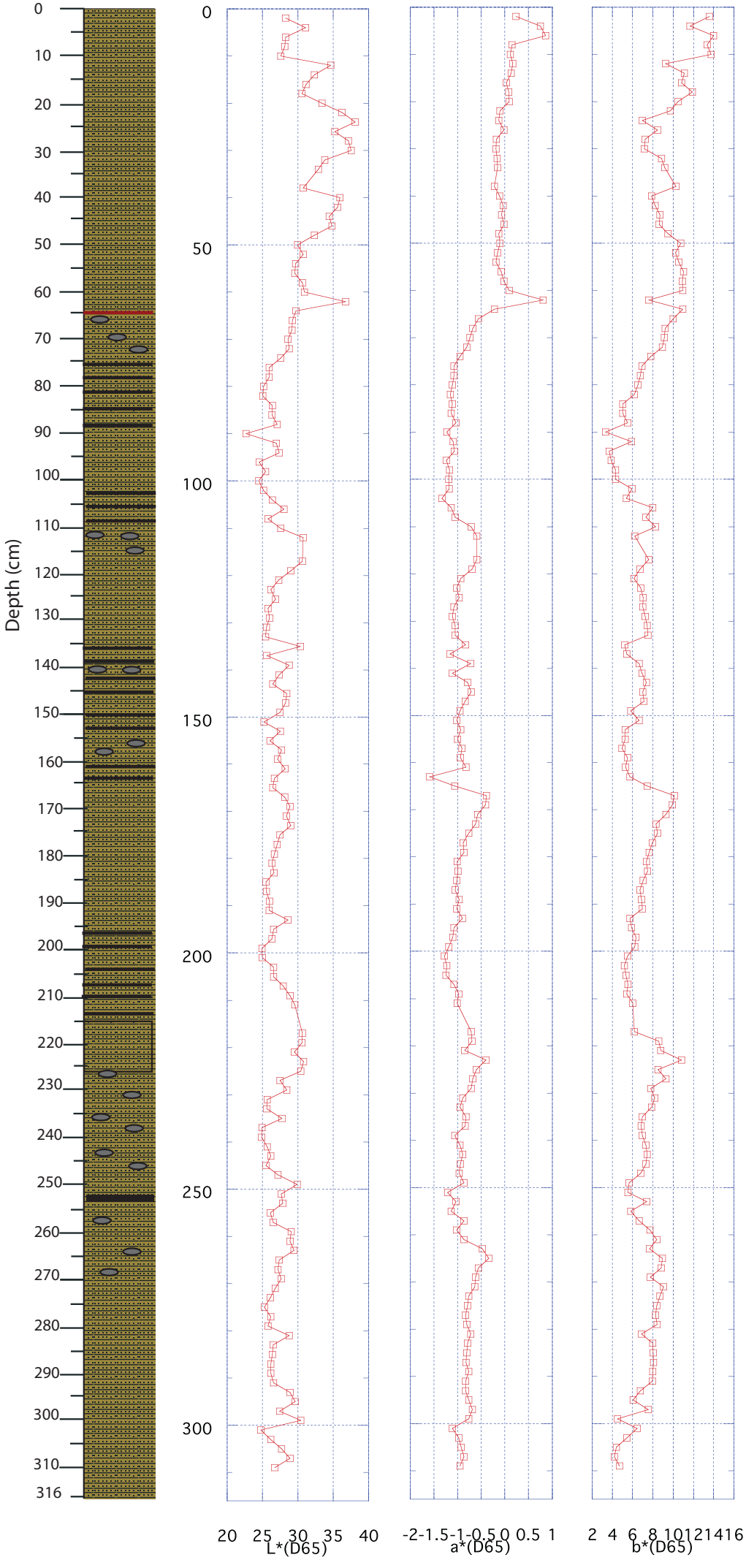
NT13-19-PC022- Sections 4, 5, 6, CC



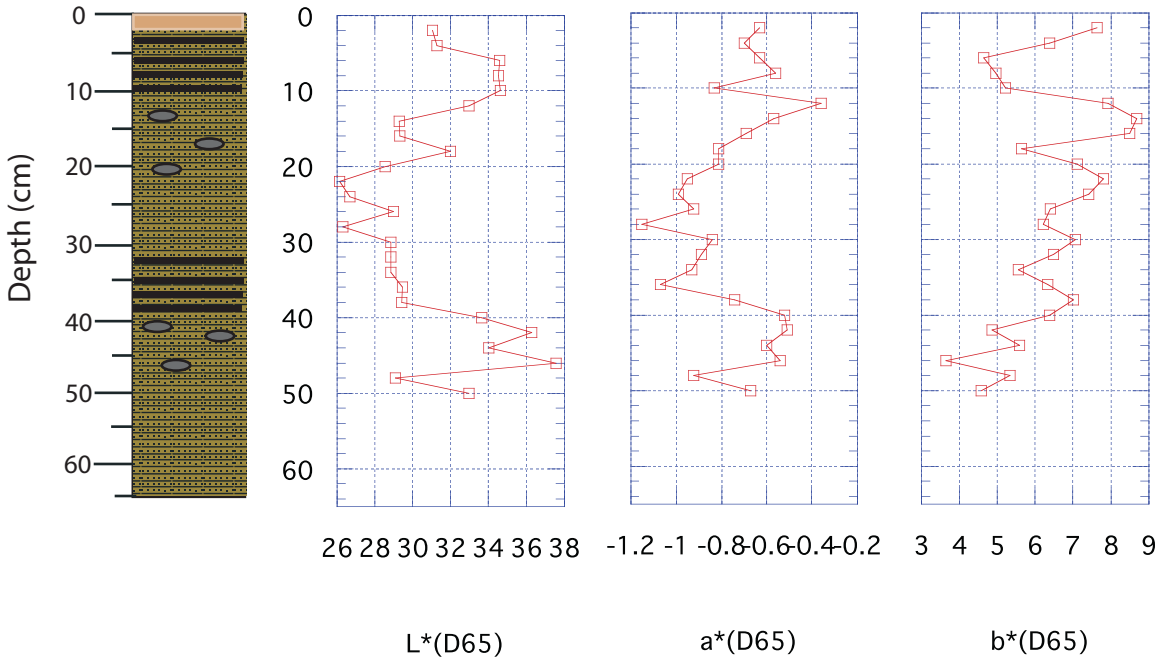
NT13-19-PL22 Section 1



NT13-19-PC023- Sections 1, 2, 3, 4



NT13-19-PL23 Section 1, CC



7. Acknowledgement

We gratefully recognize the efforts of the officers and crew of the R/V Natsushima during the cruise. We thank all the support from staffs in Research Fleet Department, JAMSTEC. Especially thanks to Mr. Yuta Yamamuro.

8. Notice on Using

Notice on using: Insert the following notice to users regarding the data and samples obtained.