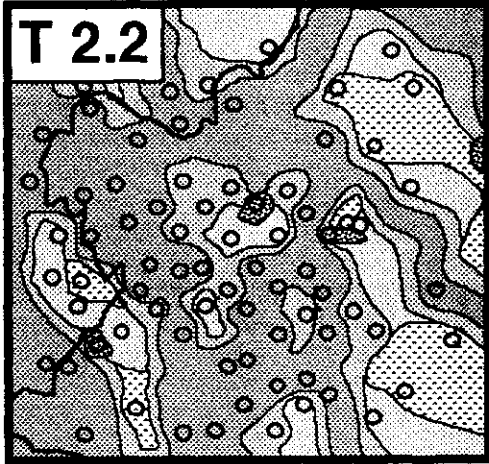


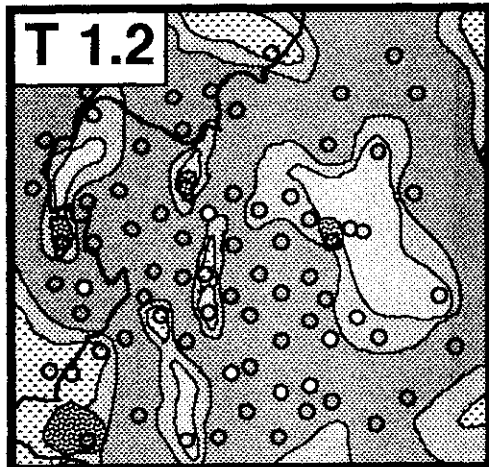
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**Ontario Geological Survey
Open File Report 5918**



**Geometry and Kaolin
Potential of Anastomosed
Stream Deposits in Late
Albian Strata of the
Mattagami Formation, Pike
Creek, Kipling Township,
Moose River Basin**



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ONTARIO GEOLOGICAL SURVEY

Open File Report 5918

Geometry and Kaolin Potential of Anastomosed Stream Deposits in Late Albian Strata of the Mattagami Formation, Pike Creek, Kipling Township, Moose River Basin

By

D.G.F. Long

1995

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Long, D.G.F. 1995. Geometry and kaolin potential of anastomosed stream deposits in Late Albian strata of the Mattagami Formation, Pike Creek, Kipling Township, Moose River Basin; Ontario Geological Survey, Open File Report 5918, 336p.

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ABSTRACT

Detailed analysis of kaolinitic sandstone, conglomerate and mudstone in 19 holes through the Cretaceous Mattagami Formation, indicate an exceptional abundance of high-constructive (anastomosed) channel deposits in a small area on the south side of the Moose River Basin. This may in part be related to basement control on the position of rivers entering the basin. Kaolin content is highest in distal flood plain facies, especially in grey (average 60%) and light brown to white mudrocks (average = 56%) which contain abundant slickensides produced by dehydration, rehydration and collapse of soil crumbs in areas with fluctuating water tables. Illite content is higher in grey, black and dark brown mudrocks (ball clays) which accumulated in areas of the floodplain with more stable seasonal water-levels. Channel deposits, of coarse sand to small pebble grade, have the lowest concentration of kaolin (average = 9%), produced by *in situ* diagenetic alteration of feldspars by acidic oxygenated groundwater in a humid tropical to subtropical climatic setting. Levee deposits, consisting mainly of medium- to very fine- sand grade material contain significant concentration of kaolin (average = 14%) and may represent a major resource.

The abundance of stacked channel, levee and splay deposits in the Pike Creek area suggests that nodal avulsion along the southern margin of the Moose River Basin played a major roll in the architectural evolution of the river systems. As it is difficult to correlate individual channels with any high degree of confidence, even with bore-holes spaced at less than 100 m apart, the kaolinite potential of the area is liable to be highly heterogenous and mining methods will have to be adapted accordingly. Paleogeographic reconstruction of the Pike Creek area suggest that anastomosed channels were typically 50 to 200 m wide, and splays less than 100 m across. Marsh and swamp environments are less common than in other parts of the Moose River Basin.

Statistical analysis indicates a close correlation of both modal grain size and facies, with chemical and physical properties of the Mattagami Formation, at least

in the vicinity of Pike Creek, hence the ultimate resource potential of the deposit and the Moose River Basin may be extrapolated with only a limited data base. While the abundance of channel deposits in this part of the Moose River Basin is high, detracting from the overall kaolin content, the relatively high reflectance of kaolin in the less than 2 μm fraction of these deposits may be of significance if it is used as a filler in the production of fine paper.

Contents

	page
ABSTRACT	v
INTRODUCTION	1
GEOLOGICAL FRAMEWORK	1
METHOD	2
NEW OBSERVATIONS	5
Stacked Sand and Gravel (Lithofacies 1)	8
Sandstone with Silt and Minor Organics (Lithofacies 2)	9
Pebbly Mudstone (Lithofacies 3)	10
Mudstones (Lithofacies 4, 5, 6, 7)	10
Lignite (Lithofacies 8, 9)	11
DEPOSITIONAL MODEL AND STRATIGRAPHIC RECONSTRUCTION ...	11
STATISTICAL RELATIONSHIPS	45
CONCLUSIONS	57
REFERENCES	60
APPENDIX 1	64
APPENDIX 2	121

List of Figures

	page
Figure 1. Location of study area.	3
Figure 2. Location of boreholes (black dots) in the study area.	4
Figure 3. Detail of Pike Creek area, showing location of Minerals Research Canada bore holes..	6
Figure 4. Effects of variations in the rates of vertical accretion and lateral migration on channel geometry in meandering and anastomosed river systems.	12
Figure 5. Stratigraphic reconstruction of the Mattagami Formatio ⁴ , Line B.	14
Figure 6. Stratigraphic reconstruction of the Mattagami Formation, Line C.	15
Figure 7. Stratigraphic reconstruction of the Mattagami Formation, Line D.	16
Figure 8. Stratigraphic reconstruction of the Mattagami Formation, Line E.	17
Figure 9. Stratigraphic reconstruction of the Mattagami Formation, Line F.	18
Figure 10. Stratigraphic reconstruction of the Mattagami Formation, Line G.	19
Figure 11. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).	21
Figure 12. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).	22
Figure 13. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).	23
Figure 14. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).	24
Figure 16. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).	25
Figure 17. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).	27
Figure 18. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).	28
Figure 19. Paleogeographic reconstruction of the central part of the Pike Creek	

	area (Figure 3).	29
Figure 20.	Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).	30
Figure 21.	Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).	31
Figure 22.	Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).	32
Figure 23.	Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).	33
Figure 24.	Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).	34
Figure 25.	Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).	35
Figure 26.	Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).	36
Figure 27.	Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).	37
Figure 28.	Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).	38
Figure 29.	Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).	39
Figure 30.	Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).	40
Figure 31.	Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).	41
Figure 32.	Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).	42
Figure 33.	Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).	43
Figure 34.	a) Grain size versus kaolin content of strata in the Mattagami	

	Formation, b) Grain size versus Fe_2O_3 content of strata in the Mattagami Formation.	48
Figure 35.	a) Grain size versus TiO_2 content of rocks of the Mattagami Formation, b) Grain size versus P_2O_5 content of strata in the Mattagami Formation.	49
Figure 36.	a) Grain size versus Zr content (ppm) b) Grain size versus Ba content (ppm).	50
Figure 37.	a) Grain size versus G.E. Brightness, b) Facies versus G.E. Brightness.	51
Figure 38.	a) Facies versus average kaolin content, b) Facies versus Fe_2O_3 .	53
Figure 39.	a) Facies versus TiO_2 content (%) b) Facies versus P_2O_5	54
Figure 40.	a) Facies versus Ba content (ppm) b) Facies versus Zr content (ppm)	55
Figure 41.	Overburden thickness in the Pike Creek area (in metres).	59

List of Tables

	page
Table 1. Lithology and interpretation of rocks of the Mattagami Formation.	7
Table 2. Grain size versus chemistry and G. E. Brightness of samples from the Mattagami Formation	47
Table 3. Lithofacies and chemistry.	52

ONTARIO GEOLOGICAL SURVEY

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**Geometry and Kaolin Potential of Anastomosed Stream Deposits in Late
Albian Strata of the Mattagami Formation, Pike Creek, Kipling Township,
Moose River Basin, Ontario**

by

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INTRODUCTION

The initial objective of this study was to examine a series of closely spaced bore-holes located in the central part of Kipling Township, to determine if detailed examination of grain-size, colour and texture of selective parts of the Cretaceous Mattagami Formation could provide a basis for three-dimensional basin, and architectural element analysis of a small part of the Moose River Basin. A secondary objective was to attempt to correlate existing information on the physical and chemical characteristics of the deposits with lithological characteristics in order to facilitate exploration and development of kaolin, silica sand and ball clay deposits in the area.

All core examined during this study was recovered from claims in Kipling Township, located approximately 90 km north of the town of Smooth Rock Falls (Figure 1). The core is currently stored at the processing facility of Mineral Research Canada, at R. R. 2, Parry Sound, Ontario (P2A 2W8).

GEOLOGICAL FRAMEWORK

Lignite, silica sand and kaolin were first reported from the Moose River Basin in the latter half of the 19th century (Bell 1877; Borron 1891). These were later found to constitute part of a thin veneer of Lower Cretaceous strata, now known as the Mattagami Formation (Keel 1920; Dyer 1928a and 1928b) which underlies approximately 7000 km² of the James Bay Lowlands. Equivalent strata have been recognised in Quebec (Remick et al. 1963) along the banks of the Lower Missiscabi River, in Manitoba (Williams 1948) at a locality 56 km southwest of Churchill, and in Ontario as karst fill in Cargill Township (Norris 1982) and along the banks of the Kabinakagami River at Limestone Rapids, 58 km west of Cretaceous strata in the Moose River Basin (Telford and Long 1986; Long 1991).

Regionally the Mattagami Formation consists predominantly of grey, black, white, yellow and red (kaolinitic) mudrocks, with lesser amounts of silica sand, lignite and gravel (Price 1978; Try et al. 1984; Telford and Long 1986; Telford et al. 1991).

It rests unconformably to disconformably on a subdued topographic surface developed on Devonian carbonates and clastics, and minor vari-coloured calcareous claystones of the Middle Jurassic Mistuskwia Beds (Telford et al. 1975; Norris 1977; Telford 1982; Long 1991). Archean strata are found along and beneath the southern margin of the basin, forming a basement high east of Adams Creek in Emerson Township. Despite their extensive areal distribution, poorly consolidated strata of the Mattagami Formation are largely obscured by an extensive cover of Pleistocene and Recent deposits. Exposures are limited to small outcrops along the banks of the Mattagami, Missinaibi and Abitibi Rivers and their tributaries. The maximum thickness of the formation is only 166 m (Try et al. 1984; Telford et al. 1991). In most localities the thickness is considerably less due to the presence of local bedrock highs combined with extensive erosion at the base of the Quaternary. Further details of the geology of the area, and prior history of exploration and research can be found in the report by Telford et al. (1991). Prior investigations in Kipling Township have been described by Giblin (1970).

METHOD

Since the comprehensive study of the Mesozoic Geology and Lignite Potential of the Moose River Basin by Telford et al. (1991), a considerable amount of drilling has taken place along the southern margin of the basin. Over 13 km of large diameter sonic core have been recovered from a 2 by 15 km area, located along the southern margin of the Moose River Basin, east of the Mattagami River, in Kipling and Emerson Townships (Figure 2). The target of this latest stage of exploration has concentrated on the kaolin, quartz and ball clay potential of the area. Drilling and bulk sampling by Mineral Research Canada has outlined suggested reserves of kaolin and ball clay in excess of 30 million tonnes (Springer 1992).

In this study 19 holes were re-logged and are presented in Appendix 1 as graphic logs, in the same format as in Try et al. (1984), Try (1984), Long (1984, 1991), Long and Graham (1993) to show grain size, colour (Munsell), sedimentary

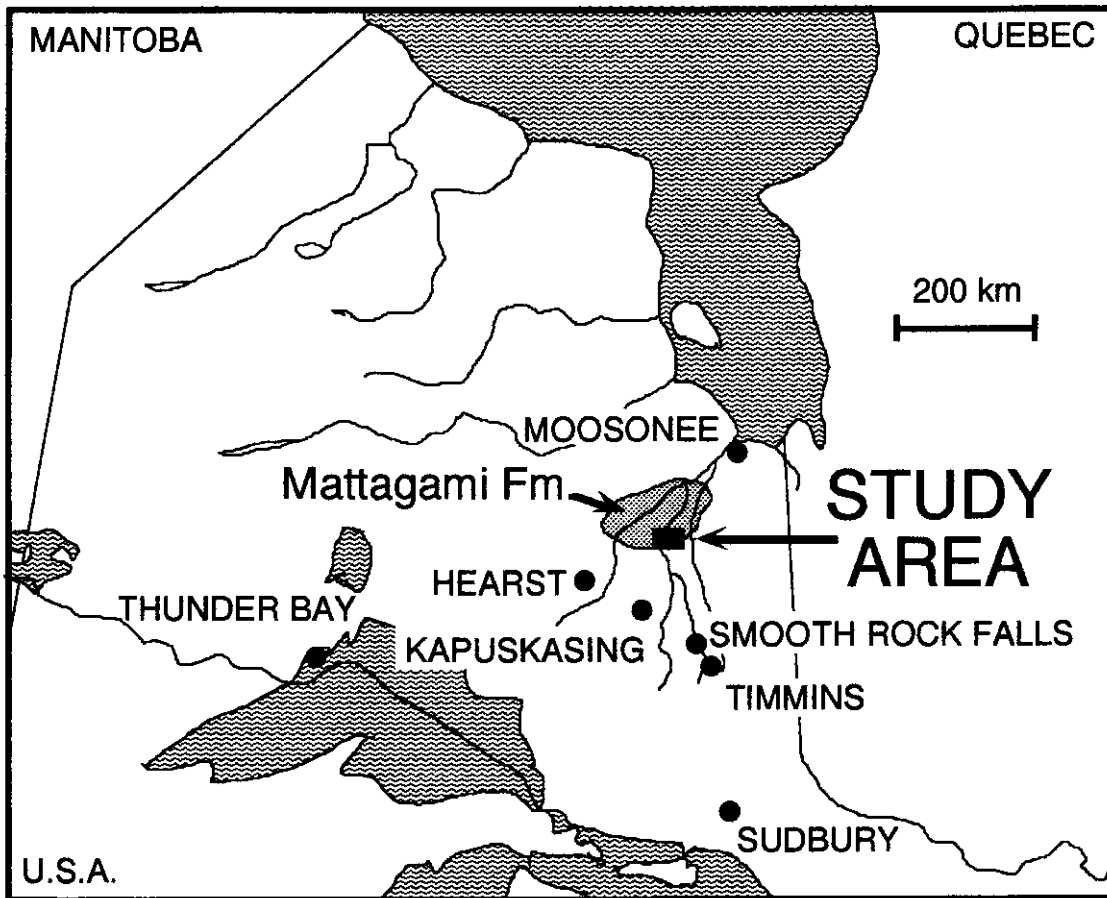


Figure 1. Distribution of Cretaceous strata in the Moose River Basin (stippled), showing location of study area.

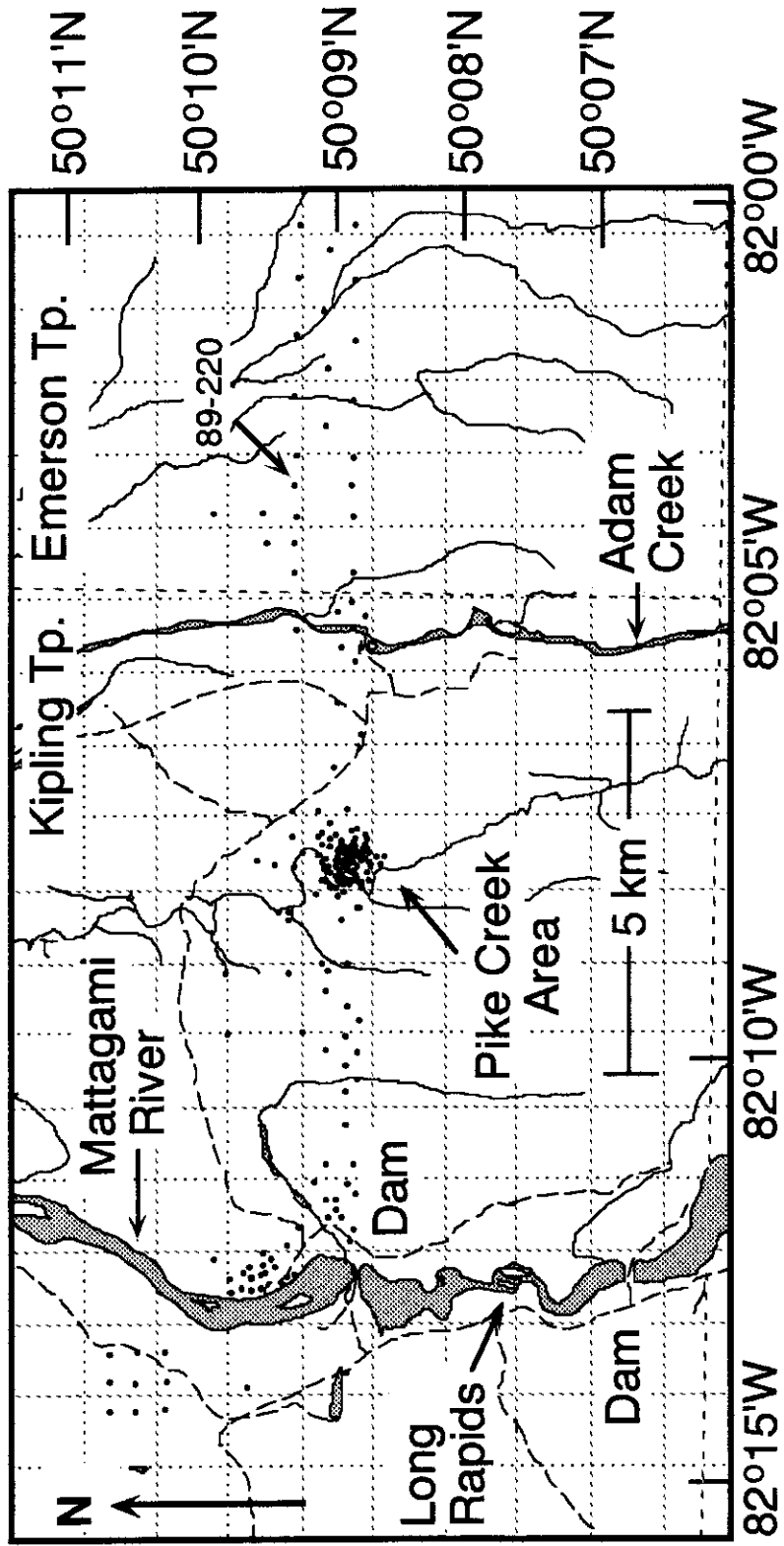


Figure 2. Location of bore holes (black dots) in Kipling and Emerson Townships.

structures and textures, the character of bed contacts, bed and bedset thickness. An estimate of the kaolin content has been added to the graphic logs, based on bulk analysis provided by Mineral Research Canada. Further data on the chemistry and "brightness" of these samples is used to attempt a statistical comparison between lithology and properties.

Most of the holes examined came from a small 1.5 by 1.5 km area adjacent to Pike Creek (Figure 3), the exception being hole 89-220, which is located 5 km further east and represents a lower stratigraphic horizon (*see* Figure 1). This area was selected as the most likely to provide information on channel widths as it has a relatively thin cover of Pleistocene strata and contains a large number of closely spaced holes. In addition to the 19 holes reexamined in this study a further 77 holes were reinterpreted in terms of depositional facies (Appendix 2) on the basis of comparison of the new logs of the first 19 holes with drill hole logs by A. Casselman, provided by Minerals Research Canada.

The above data are used to attempt a detailed geometric analysis of deposit architecture. Sandstone bodies in the Mattagami Formation have a complex interconnected shoe-string geometry, related to deposition on a low gradient fluvial plain by multiple channel, anastomosed rivers (Try et al. 1984; Try 1984; Long 1991). The complexity of these systems requires very detailed logging in order to predict the extent to which channels are connected, and their lateral extent (Smith 1983, 1986; Smith and Putnam 1980; Smith and Smith 1980; Long 1984, 1991; Long and Graham 1993; Long and Sweet 1994).

NEW OBSERVATIONS

As in previous studies of the Mattagami Formation strata can be grouped into 9 major lithofacies assemblages, each of which formed in a distinctive depositional setting (Table 1: after Try et al. 1984 and Long 1991).

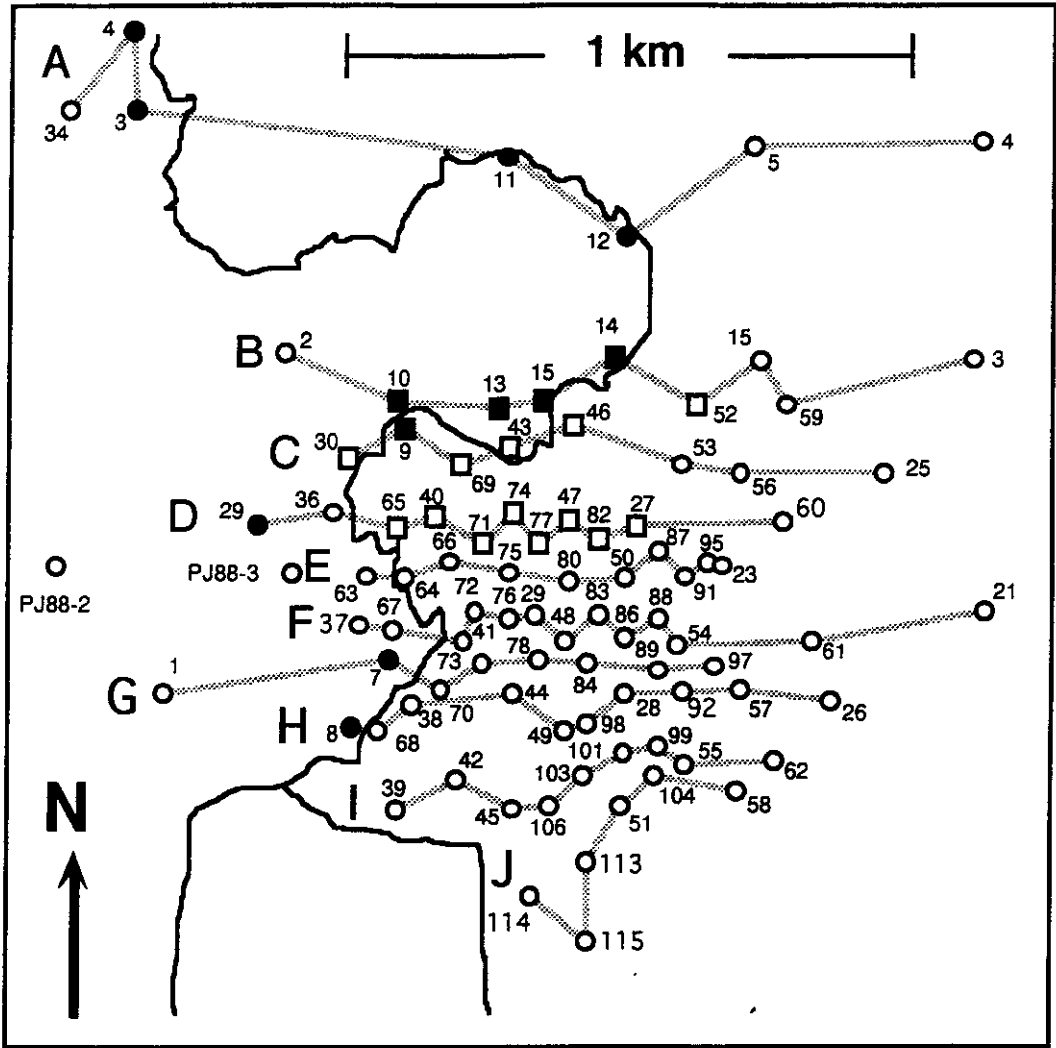


Figure 3. Detail of Pike Creek area, showing location of Minerals Research Canada bore holes. Black dots represent holes sunk in 1992, white dots represent 1989 holes. PJ88-2 and 3 were sunk in 1988. B to G are locations of cross-sections in Figures 5 to 10.

Table 1. Lithology and interpretation of rocks of the Mattagami Formation.

1. Sandstone (kaolinitic), medium to very flat bedded, cross bedded.	Channel fill, channel lag
2. Sandstone (kaolinitic), medium to very fine grained, with minor conglomerate, siltstone and organics (flat to wavy laminated)	Levee and Splay deposits
3. Pebbly Mudstone (massive)	Crevasse splay and flood deposits
4. Black, organic rich mudrocks (massive, flat to wavy laminated)	Floodplain swamps: organic accumulation exceeds oxidation
5. Grey Mudstone (massive, some roots and woody lignite preserved)	Floodplain marsh: limited oxidation
6. White, yellow, brown and red mudrocks (massive with slickensides and other soil textures)	Floodplain with extensive oxidation, leaching and soil formation
7. Laminated mudstone	Lake or pond deposits
8. Dull muddy lignite	Lowland reed moor or telemic moor, floodplain swamp
9. Woody lignite	Forest moor, channel margin swamps and raised bogs

Deposits of the Pike Creek area differ from previous studies only in their relative abundance. While Try et al. (1984) and Long (1991) indicate that the bulk of the Mattagami Formation consists of grey, black, white, yellow and red mudrocks with lesser amounts of poorly consolidated silica sand, gravel and lignite, the bulk of the preserved material (55%) in core from the Pike Creek area consists of medium- to very coarse-grained kaolinitic silica sand and gravel of channel origin. Finer grained sands and minor associated gravel of levee and splay origin (facies assemblage 2 in Table 1) form 30% of the local sequence, while other facies form only 15%. Further details of each facies assemblage are provided below.

Stacked Sand and Gravel (Lithofacies 1)

Gravel is prominent in the channel facies of the Pike Creek area. It occurs in composite sets up to 2 m thick in intimate association with kaolinitic sands of medium- to very coarse-sand grade. The gravels are commonly well sorted to very well sorted with a median grain size in the granule to large pebble range. They are dominated by well rounded pebbles of vein quartz derived from the Precambrian Shield, and grey to black cherts derived from the Precambrian and local Paleozoic strata. The abundance of fossiliferous cherts in some sections suggests that Paleozoic Carbonates may have been present as a thin cover over parts of the Precambrian Shield south of the Moose River Basin at the time of deposition of the Mattagami Formation. Pebble sized patches of kaolin in the conglomerates appear to represent clasts of feldspar which have been degraded after deposition of the conglomerates. Lignite spars and mudstone intraclasts are present locally.

Stacked sequences of medium to very coarse grained sand, with minor conglomerate are a common feature of the Mattagami Formation in the Pike Creek Area. Most appear massive in core, although plane bedding and cross lamination is apparent locally. Beds are typically less than 60 cm thick, although many apparently thicker units have been recorded in the logs due to absence of marked grain size changes or distinctive bed contacts in parts of the core. Sets range from a few metres

to 28.5 m thick (hole 89-30, Appendix 1). They tend to have abrupt upper and lower contacts, with little to no evidence of systematic fining upwards trends. Most of the channel fill units show only minor, non-systematic grain size changes (cf. Hole 89-30, 54-28 m level, *see* Appendix 1). Mud drapes may be preserved locally, as may be thin sets of medium- to very fine-sand. Mudstone intraclasts in the channel fills may reflect reworking of mud drapes or plugs during rising flood stage.

In places the occurrence of stacked sand and gravel sequences is heralded by the presence of thin plane bedded gravels of splay origin in underlying mudstones (Hole 89-40, 25 and 19 m levels; hole 89-52 37 m level, *see* Appendix 1) or finer sands (Hole 89-46, 49-50 m level; Hole 89-69 64 m level, *see* Appendix 1).

Most of the sands are white due to the abundance of kaolin produced by *in situ* diagenetic alteration of detrital feldspars. Some beds appear light brown, yellow or red due to the presence of minor accessory minerals or diagenetic cements. Heavy mineral concentrations are apparent locally in the medium grained sands. These may contain concentrations of hornblende, pink garnet, magnetite, ilmenite and rutile (Hamblin 1982).

Sandstone with Silt and Minor Organics (Lithofacies 2)

Massive, flat and wavy laminated, well sorted to very well sorted, medium, fine and very fine kaolinitic quartz sands form about 30% of the local sequence in the Pike Creek area. In outcrops along Adam Creek they are found adjacent to channel fill sand and gravel units (Try et al. 1984) and are interpreted as splay deposits. In cores they are typically found in intimate association with channel sands and gravels, often occurring above thick stacked channel sequences (Hole 92-14, 24-31 m level, *see* Appendix 1). Locally they contain concentrations of transported organic material and heavy minerals. Fining upwards trend are noted locally (Hole 89-27, 73-68 m level; Hole 94-14, 55-58 m level, *see* Appendix 1) but are not ubiquitous. Fine and very fine sand units may be interbedded with floodplain muds. Thin sets of gravel and coarse-

to very coarse-sand associated with these levee deposits are interpreted as splays. The abundance of mudstone intraclasts in some of these units suggests partial reworking of stream banks or mud drapes on levees during floods (Hole 92-9, 71 m level; Hole 89-65, 22 m level *see* Appendix 1).

Most of the medium- to very fine-sand units in the Mattagami Formation appear white in core, minor colours include light grey, light brownish grey, pale yellow, pale olive and reddy-yellow. Brown and yellow colours are enhanced by wetting the core.

Pebbly Mudstone (Lithofacies 3)

Pebbly mudstones and massive sandy mudstone units of flood origin are very rare in the Pike Creek area. They occur at the transition from floodplain muds to channel deposits in hole 89-27 (34 m level, *see* Appendix 1), and above a channel sand in hole 92-15 (43 m level, *see* Appendix 1).

Mudstones (Lithofacies 4, 5, 6, 7)

Regionally mudstones form over 50% of the Mattagami Formation, in the Pike Creek area they represent less than 15% of the section encountered in cores. Black, organic-rich mudstones are comparatively rare (more than 5%) in the Pike Creek area. Locally dark grey and black mudstones are found in association with lignite (92-13, 71 m level; 92-14, 64-65 m level, *see* Appendix 1). This is more evident in hole 89-220 (51 m level, *see* Appendix 1), which is located 4.5 km east of the Pike Creek area, and may represent a stratigraphically lower unit.

White and grey muds are present in almost equal proportions. The white muds commonly have well developed slickensides and ped textures. Grey to grey-brown muds often show well developed ped textures and slickensides, as well as minor roots and dispersed organic material. Yellow and red muds are developed locally. The red muds are often mottled (with white) and typically have well developed soil textures.

Murray et al. (1984) suggests that the red colours may be related to the presence of siderite and hematite.

Thin sets of laminated mud are present locally (Hole 89-52, 37-38 m level; Hole 89-69, 24 m level; Hole 89-71, 24 m level; 92-9, 20-21 m level; Hole 92-13, 27 m level; 92-14, 70 m level, *see* Appendix 1); they may be white to light olive grey and can locally contain dispersed organic material.

Lignite (Lithofacies 8, 9)

Lignite is only of minor importance in the core from the Pike Creek area. In hole 92-13 (71 m level, *see* Appendix 1) and 92-14 (65 m level, *see* Appendix 1) it is a predominantly dull muddy coal and is too thin to be of any importance. The 1 m thick coal seam in Hole 89-220 may be at a stratigraphically lower level than strata encountered in the Pike Creek area (*see* Appendix 1).

DEPOSITIONAL MODEL AND STRATIGRAPHIC RECONSTRUCTION

Strata in the Pike Creek area of Kipling Township appear to have similar characteristics to the Mattagami Formation in other parts of the Moose River Basin, and as such can be interpreted in terms of deposition from a low gradient, high constructive (anastomosed) rivers in which bank stability was maintained by dense vegetation (Try et al. 1984; Try 1984; Long 1991). High-constructive (anastomosed) stream deposits tend to have relatively high vertical accretion rates, which when combined with low rates of lateral facies migration, produce very little lateral continuity between adjacent bore holes (Figure 4). Field observations in the Adam Creek area by Try et al. (1984) and Long (1991) indicate that channel, levee, floodplain and marsh facies can coexist in very close proximity. Stratigraphic reconstruction of the Pike Creek area (Figures 5 to 10) supports this hypothesis.

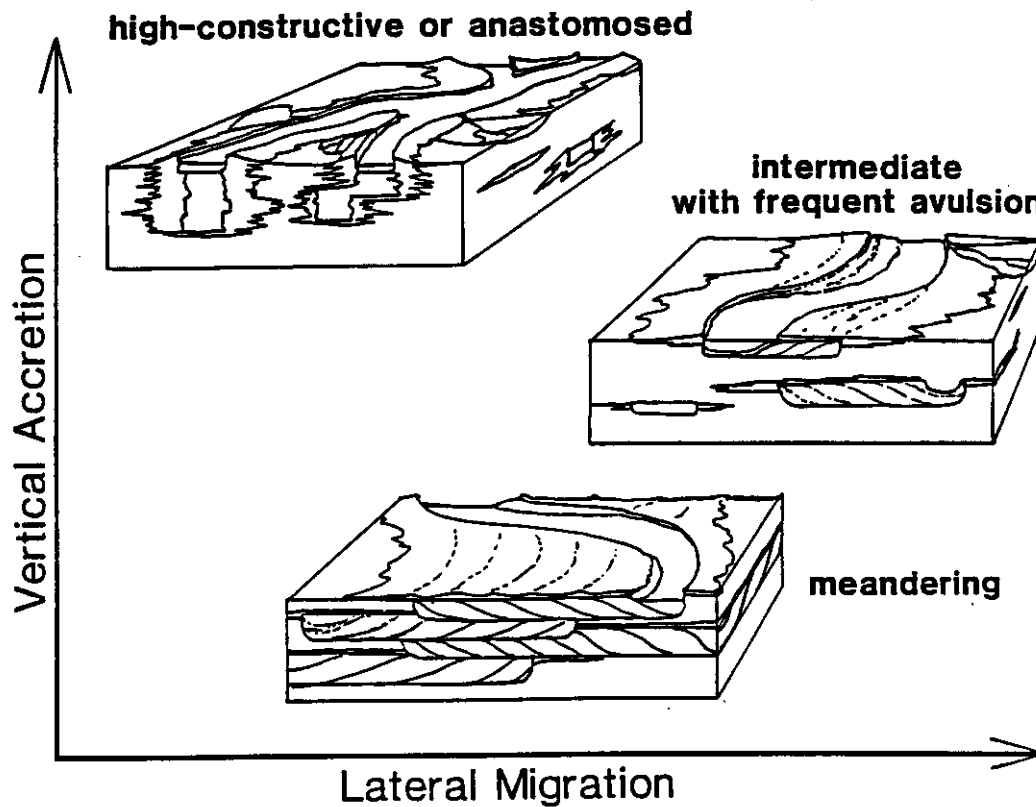


Figure 4. Effects of variations in the rates of vertical accretion and lateral migration on channel geometry in meandering and anastomosed river systems (from Long and Graham 1993).

The major lithotypes in the Pike Creek area can be interpreted in terms of deposition in channel, levee, splay and marsh environments (*see* Table 1). Pebbly mudstones and coals are rare. Specific interpretation of individual cores examined during this study are included in Appendix 1 and Appendix 2.

Stacked sand and gravel sequences (lithofacies 1) are interpreted as channel fill deposits, with minor grain-size fluctuations reflecting channel aggradation during rising and falling flood stages (*cf.* Smith 1983; Long and Graham 1993). Minor mudstone units may reflect local slack-water conditions in the channels. The general paucity of distinct fining upwards sequences in the channel fill sequences indicates that point bars, typical of deposition in high-sinuosity meandering river systems were not common in the river system responsible for deposition of this part of the Mattagami Formation. The sharp upper and lower contacts of many of the stacked sand and gravel sequences in the Pike Creek area suggests that many of these were avulsion controlled. Crevasse development in more proximal parts of the river system apparently led to rapid redirection of the river system, such that full abandonment sequences were not developed. Channels exposed in Adam Creek are between 10 and 50 m wide (Try *et al.* 1984). Apparent widths of channels in the Pike Creek area are from less than 50 m to more than 500 m (*see* Figures 5 to 10). As the stratigraphic cross-sections are based on the drilling pattern, and not the depositional fabric the true width of the channel systems is difficult to evaluate. Paleogeographic reconstructions at 20 arbitrary levels (2 m apart stratigraphically) within the Pike Creek area indicates a complex anastomosed pattern of shoe-string like channels, with widths of 45 to 250 m (Figures 10 to 32). Given that most of the channel fill sequences are between 10 and 15 m thick, the minimum width to depth ratios range from 15:1 to 3:1; the real values are probably somewhat higher.

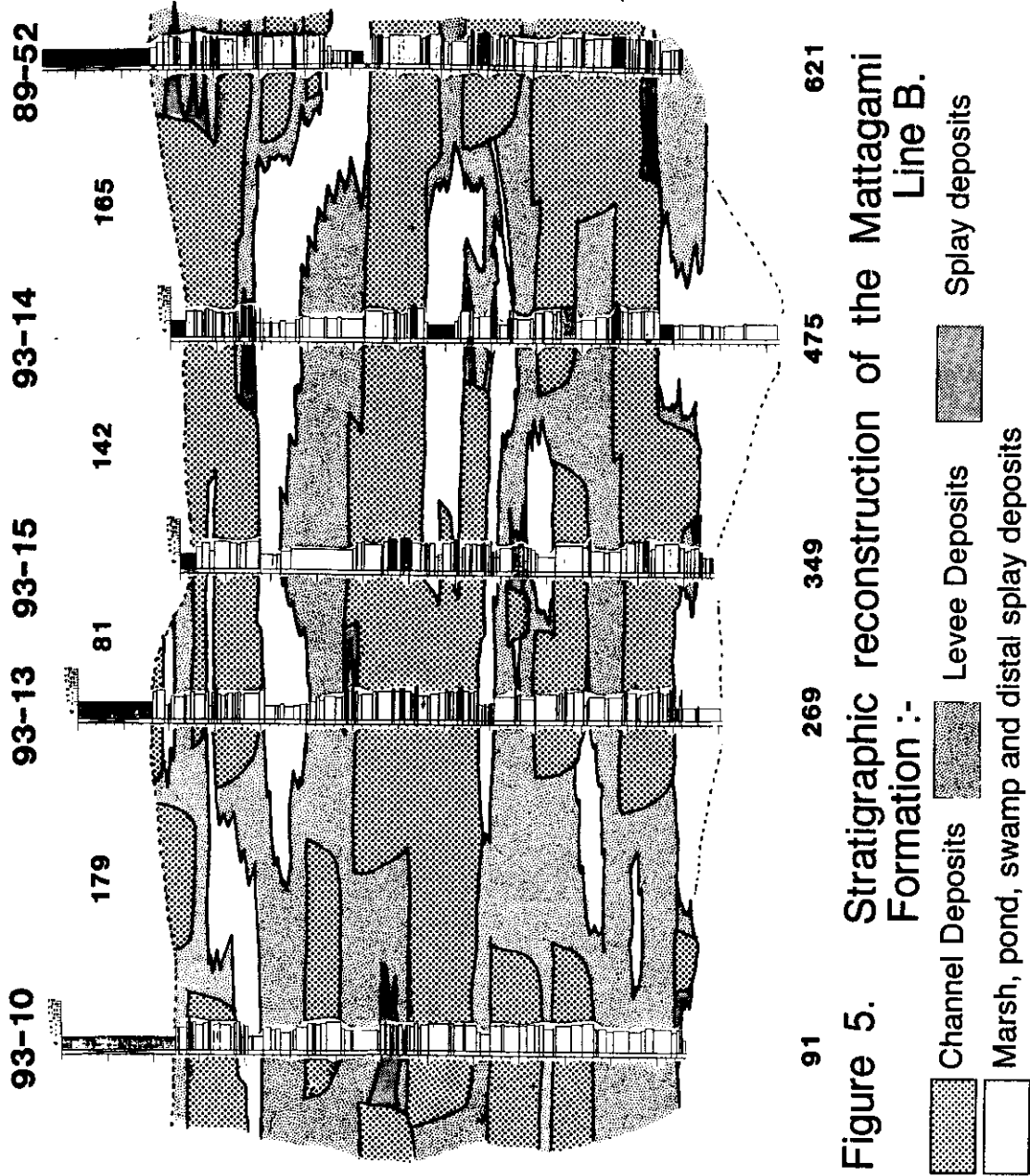


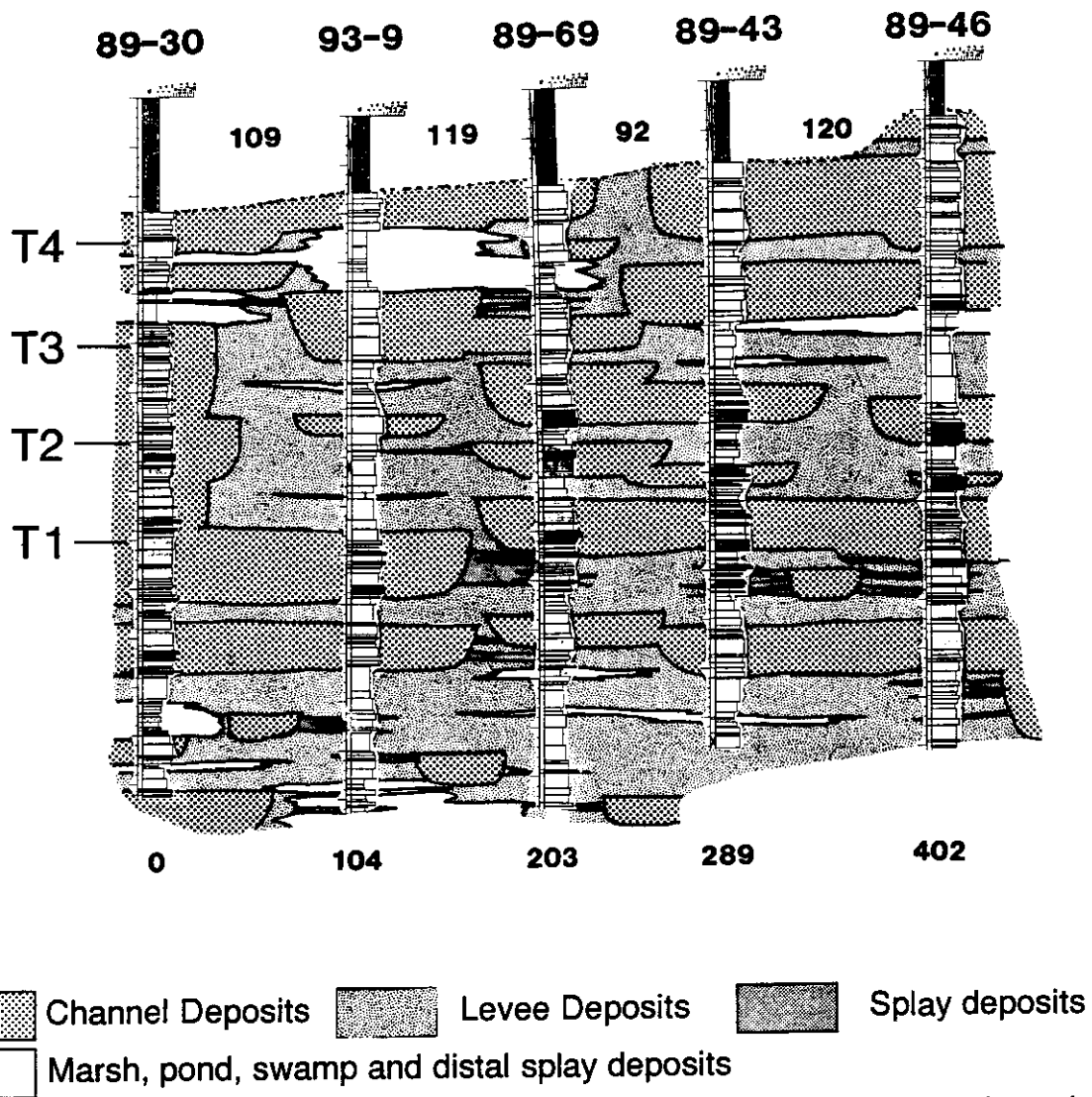
Figure 5. Stratigraphic reconstruction of the Mattagami Line B.

Formation :-

- Channel Deposits
- Marsh, pond, swamp and distal splay deposits
- Levee Deposits
- Splay deposits

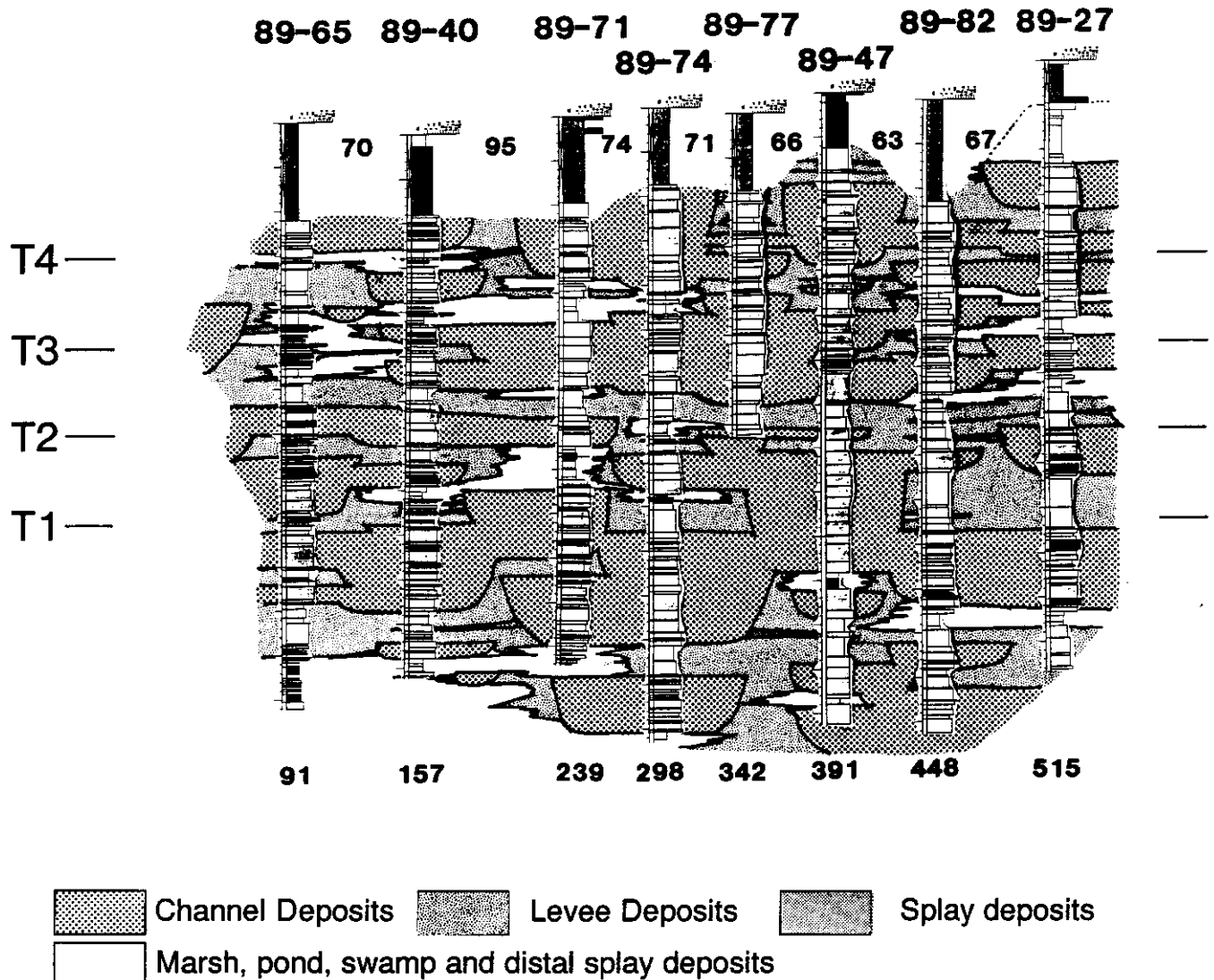
Hole number above section. Number between sections is spacing in metres; number at base of section is distance east of hole 89-30 in metres. T1 to T4 are planes of correlation used in construction of paleogeographic maps.

T4—
T3—
T2—
T1—



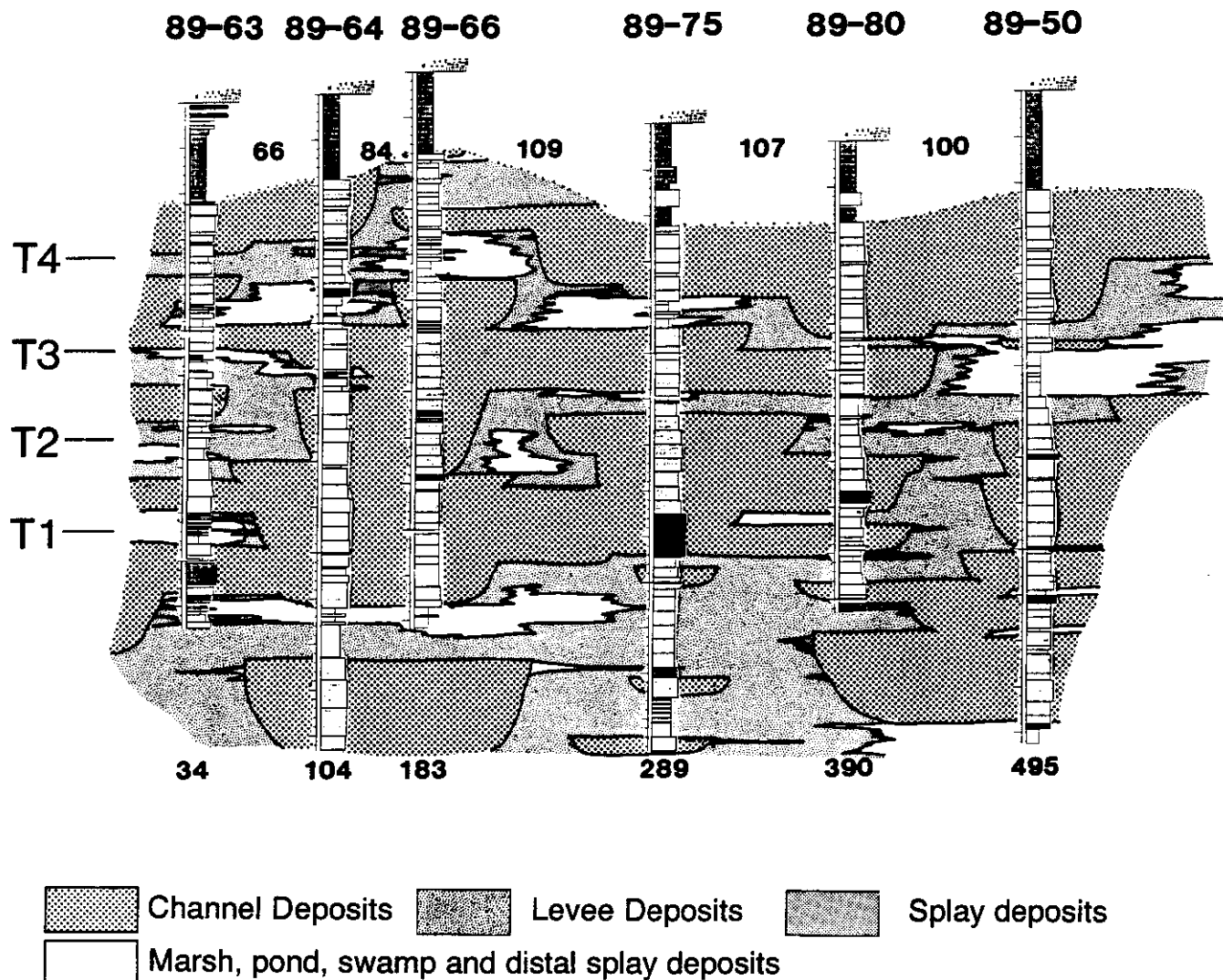
Hole number above section. Number between sections is spacing in metres; number at base of section is distance east of hole 89-30 in metres. T1 to T4 are planes of correlation used in construction of paleogeographic maps.

Figure 6. Stratigraphic reconstruction of the Mattagami Formation, Line C.



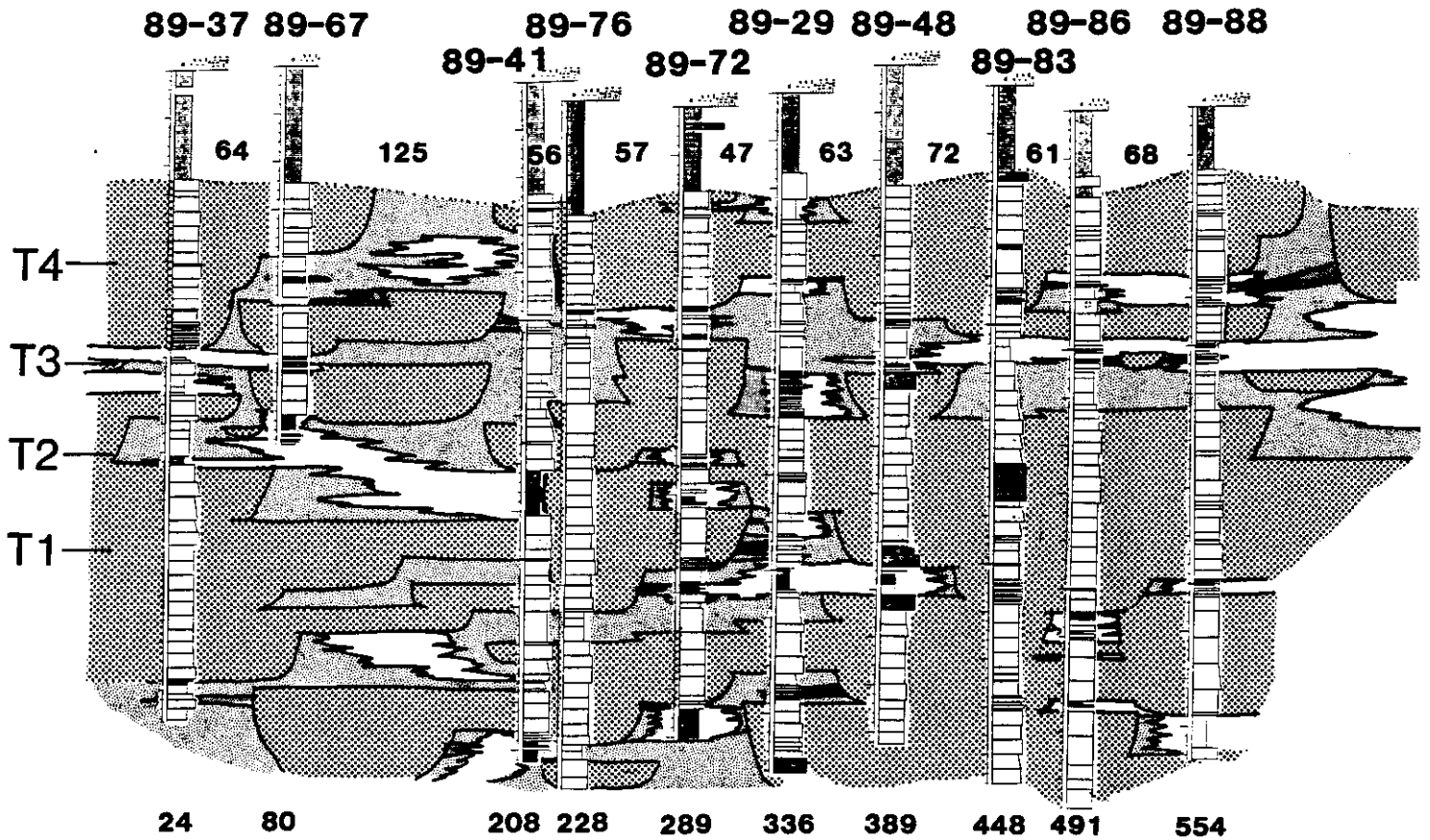
Hole number above section. Number between sections is spacing in metres; number at base of section is distance east of hole 89-30 in metres. T1 to T4 are planes of correlation used in construction of paleogeographic maps.

Figure 7. Stratigraphic reconstruction of the Mattagami Formation, Line D.



Hole number above section. Number between sections is spacing in metres; number at base of section is distance east of hole 89-30 in metres. T1 to T4 are planes of correlation used in construction of paleogeographic maps.

Figure 8. Stratigraphic reconstruction of the Mattagami Formation, Line E.



Channel Deposits
 Levee Deposits
 Splay deposits
 Marsh, pond, swamp and distal splay deposits

Hole number above section. Number between sections is spacing in metres; number at base of section is distance east of hole 89-30 in metres. T1 to T4 are planes of correlation used in construction of paleogeographic maps.

Figure 9. Stratigraphic reconstruction of the Mattagami Formation, Line F.

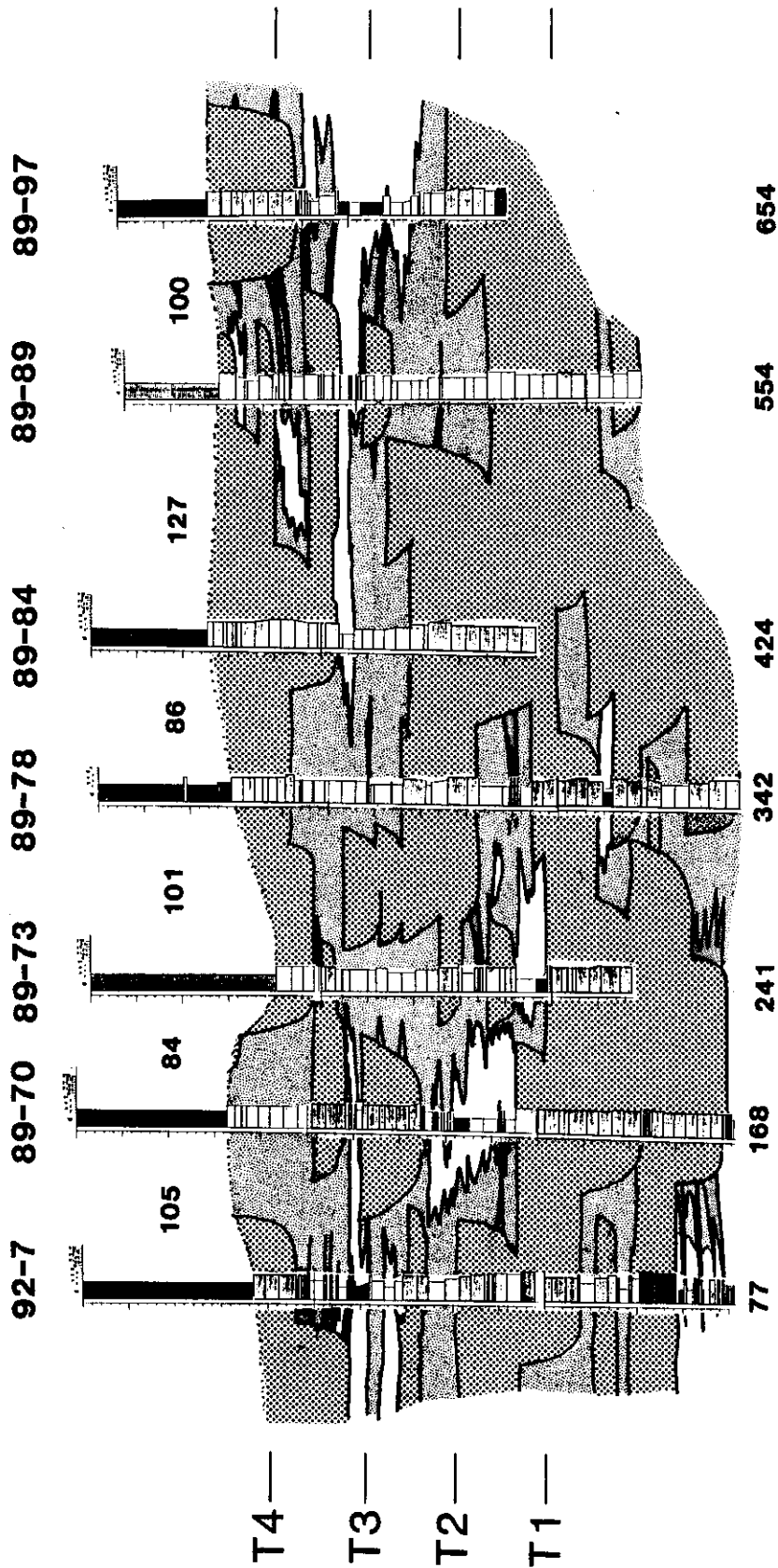


Figure 10. Stratigraphic reconstruction of the Mattagami Line G.

Formation :-

- Channel Deposits
- Marsh, pond, swamp and distal splay deposits
- Levee Deposits
- Splay deposits

Hole number above section. Number between sections is spacing in metres; number at base of section is distance east of hole 89-30 in metres. T1 to T4 are planes of correlation used in construction of paleogeographic maps.

Massive, flat and wavy laminated medium, fine and very fine sandstones, with minor silt and organics (lithofacies 2) are interpreted as levee and splay deposits. Proximal splay deposits tend to be coarser grained (including medium to very coarse sandstone, granule and small pebble conglomerate). These tend to be associated with floodplain and floodpond muds, suggesting high local gradients developed on either side of the stream channels as they aggraded. This is in places confirmed by the common occurrence of abundant mudstone intraclasts, reflecting reworking of levee and floodplain marsh deposits during flood events. Paleogeographic reconstructions of the Pike Creek area (see Figures 11 to 33) suggest that levees of fine- to medium-sand grade extended as wedge shaped bodies, 20 to 100 m from the channel margins. These appear to grade into very fine sands and sandy mudstones of distal levee and oxidised floodplain facies. Proximal splay deposits are rarely encountered at the same level in adjacent holes, so their lateral continuity may have been limited to 50 to 150 m from the channel walls. Modern splay deposits tend to be fan-shaped wedges, best developed on the lower parts of the levee complex.

Pebbly mudstones (lithofacies 3) are rare in the Pike Creek area, their occurrence at transitions from floodplain muds to channel sands and gravels supports a flood origin (Try *et al.* 1984, Figure 9). Too few examples of this facies were encountered to provide evidence of their architecture, although they may be confined to crevasse fills.

Mudstones and sandy mudstones in the Pike Creek area (Lithofacies 4 to 7) are interpreted as overbank deposits. The paucity of black, organic rich mudstones (Lithofacies 4) suggest that marsh settings where the rate of organic accumulation exceeded the rate of oxidation were comparatively rare. This is supported by the paucity of coals (Lithofacies 8, 9) which typically indicate the development of more permanent marsh and swamp environments in which the water table remained at or near the surface for most of the year.

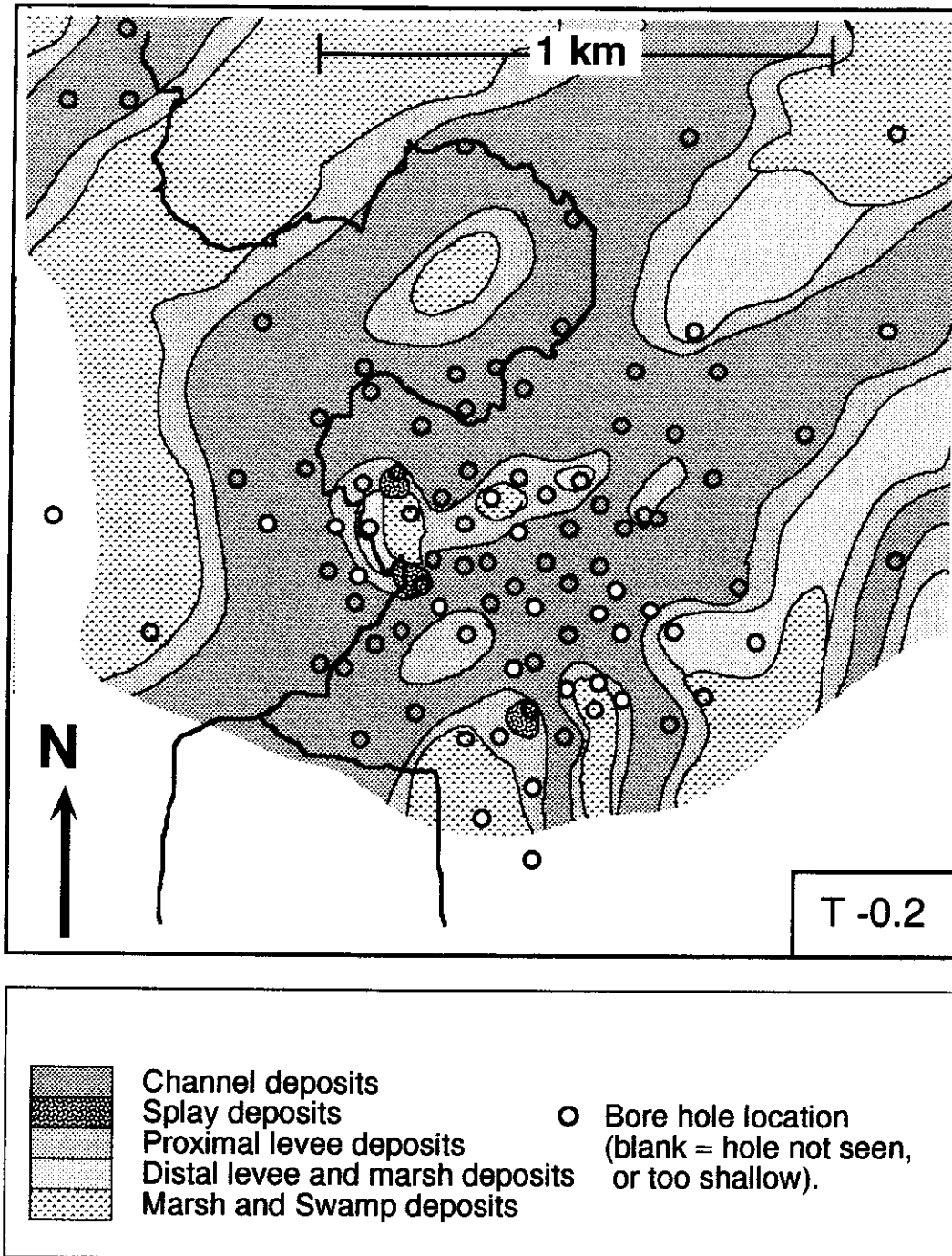


Figure 11. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

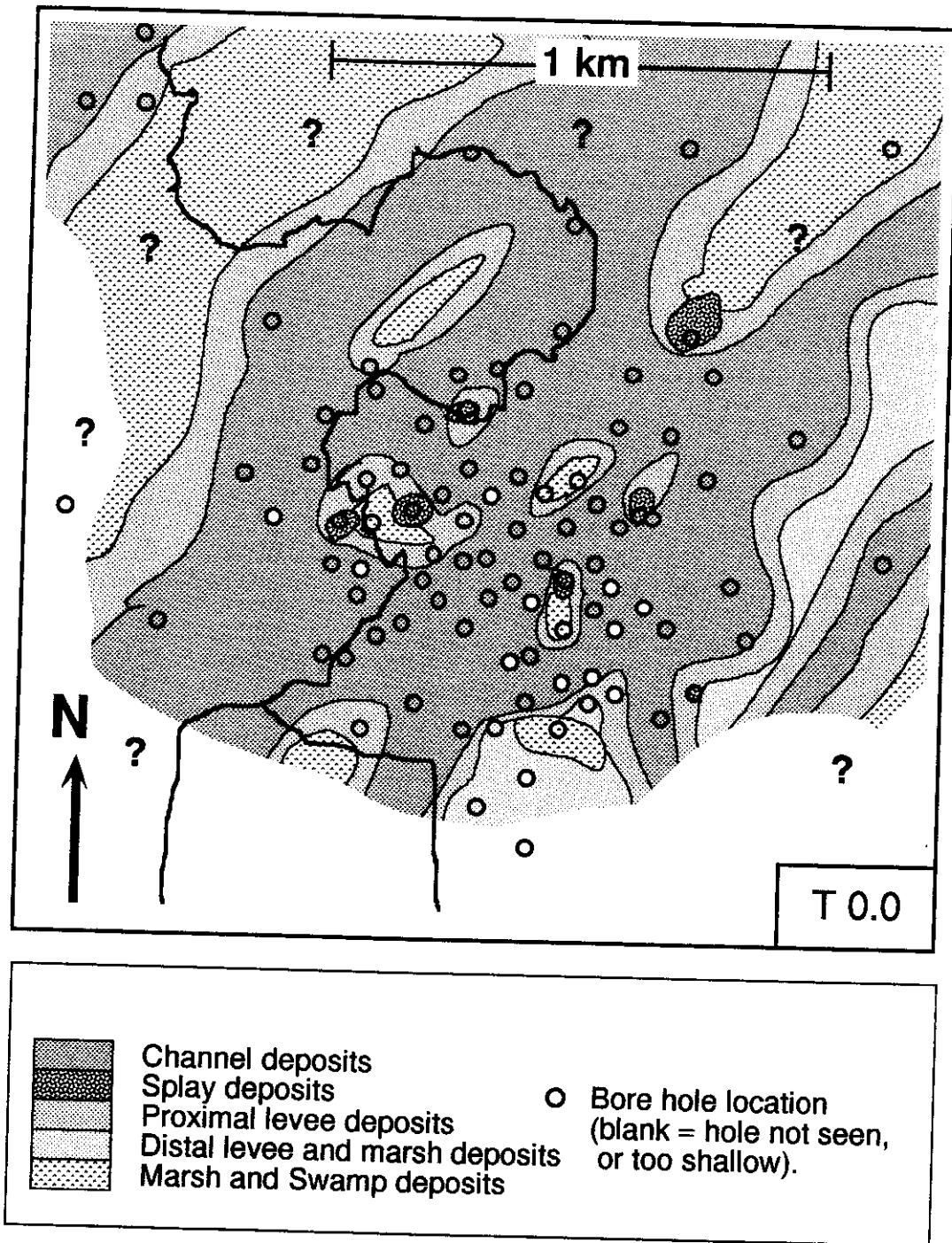


Figure 12. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

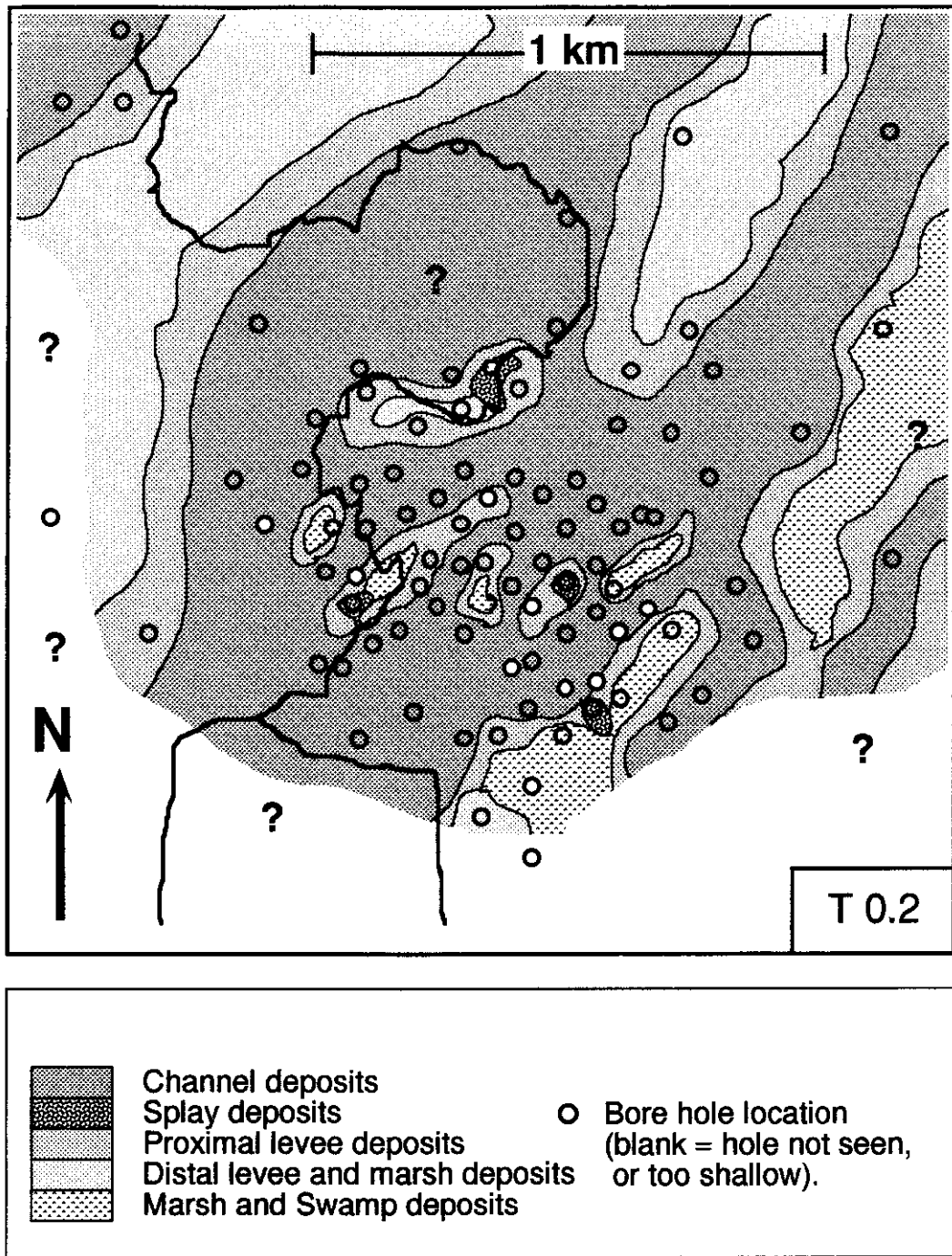


Figure 13. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

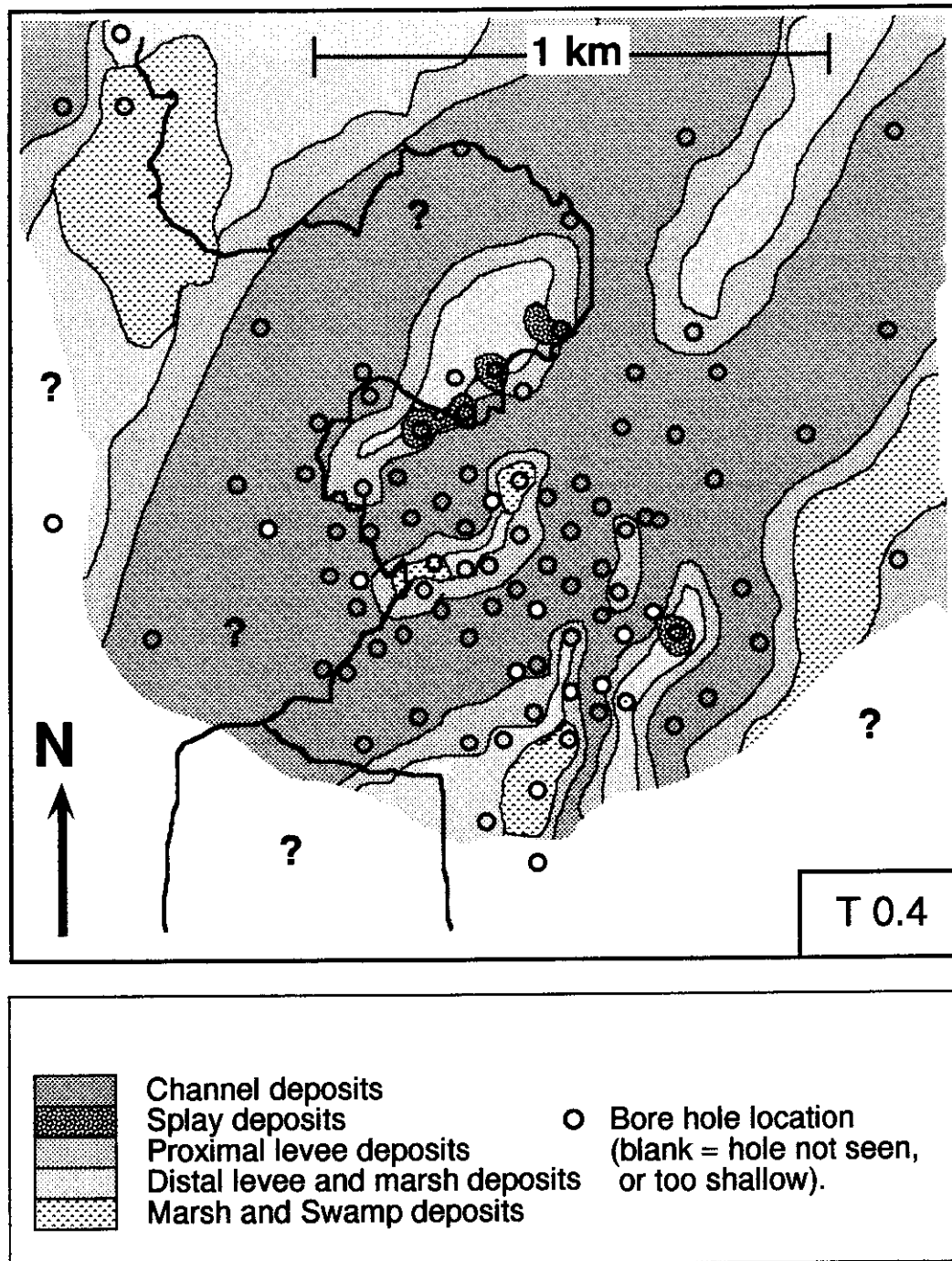


Figure 14. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

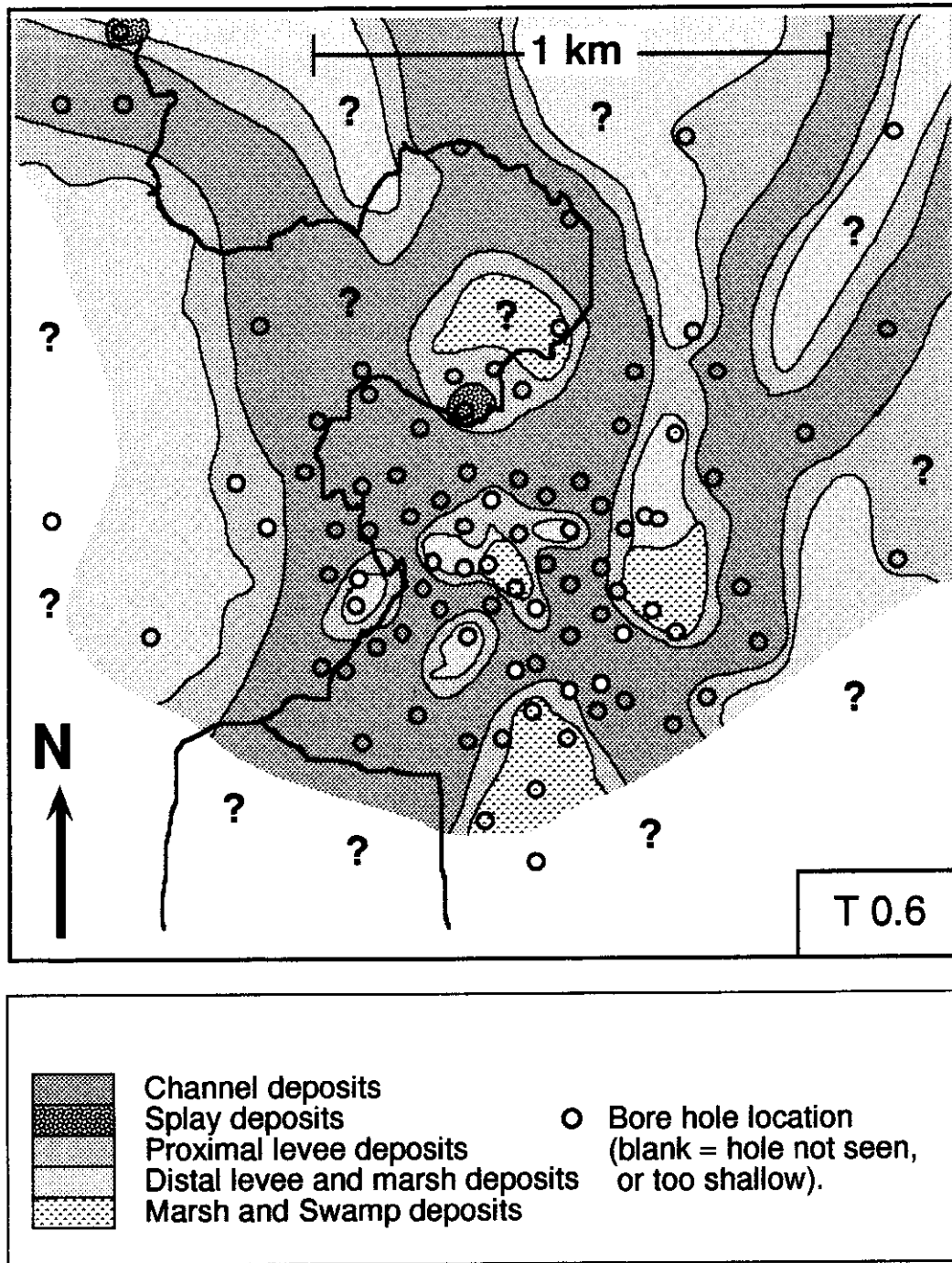


Figure 15. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

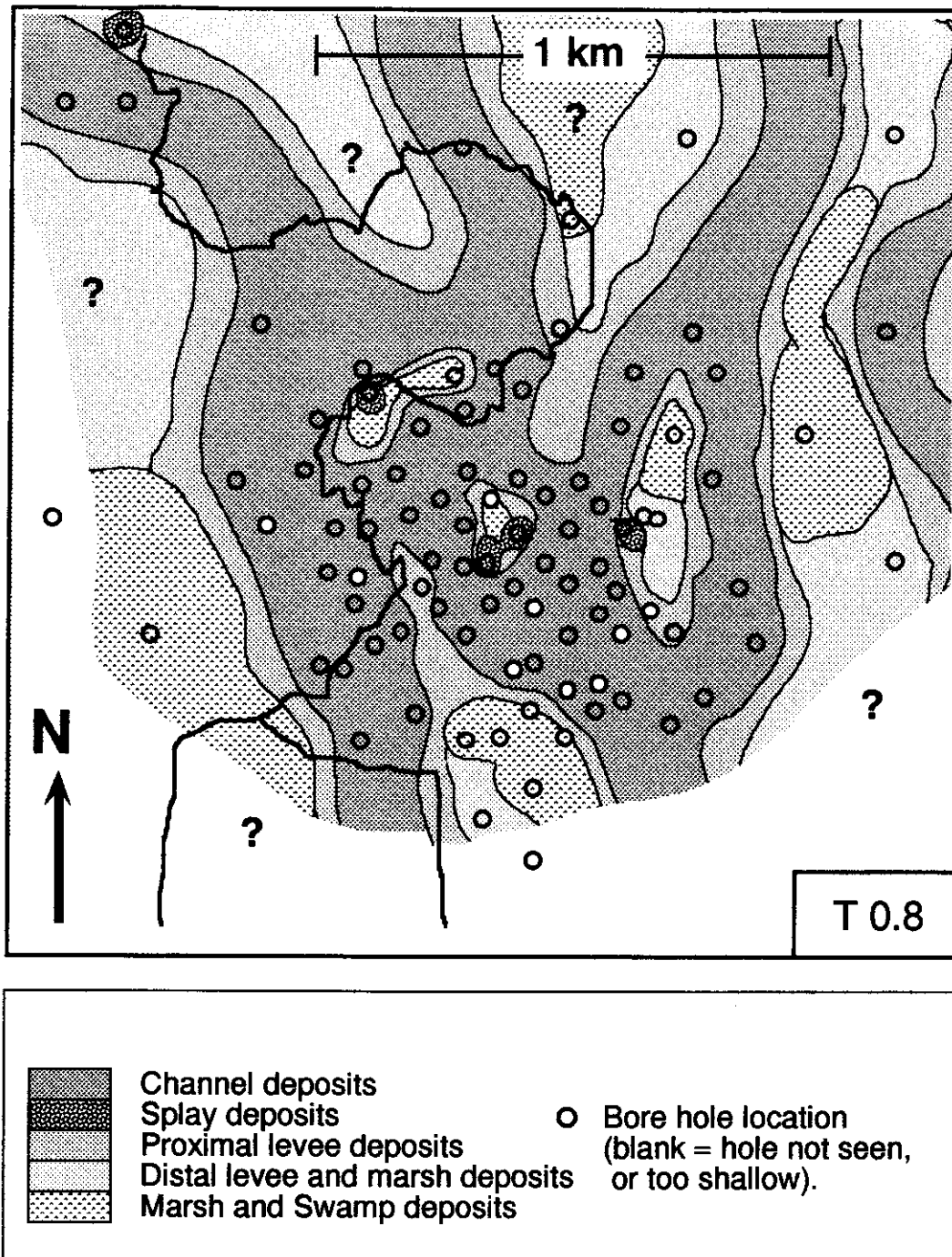


Figure 16. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

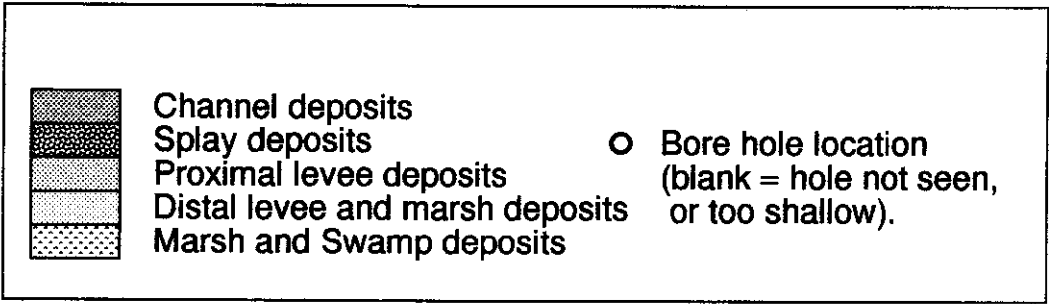
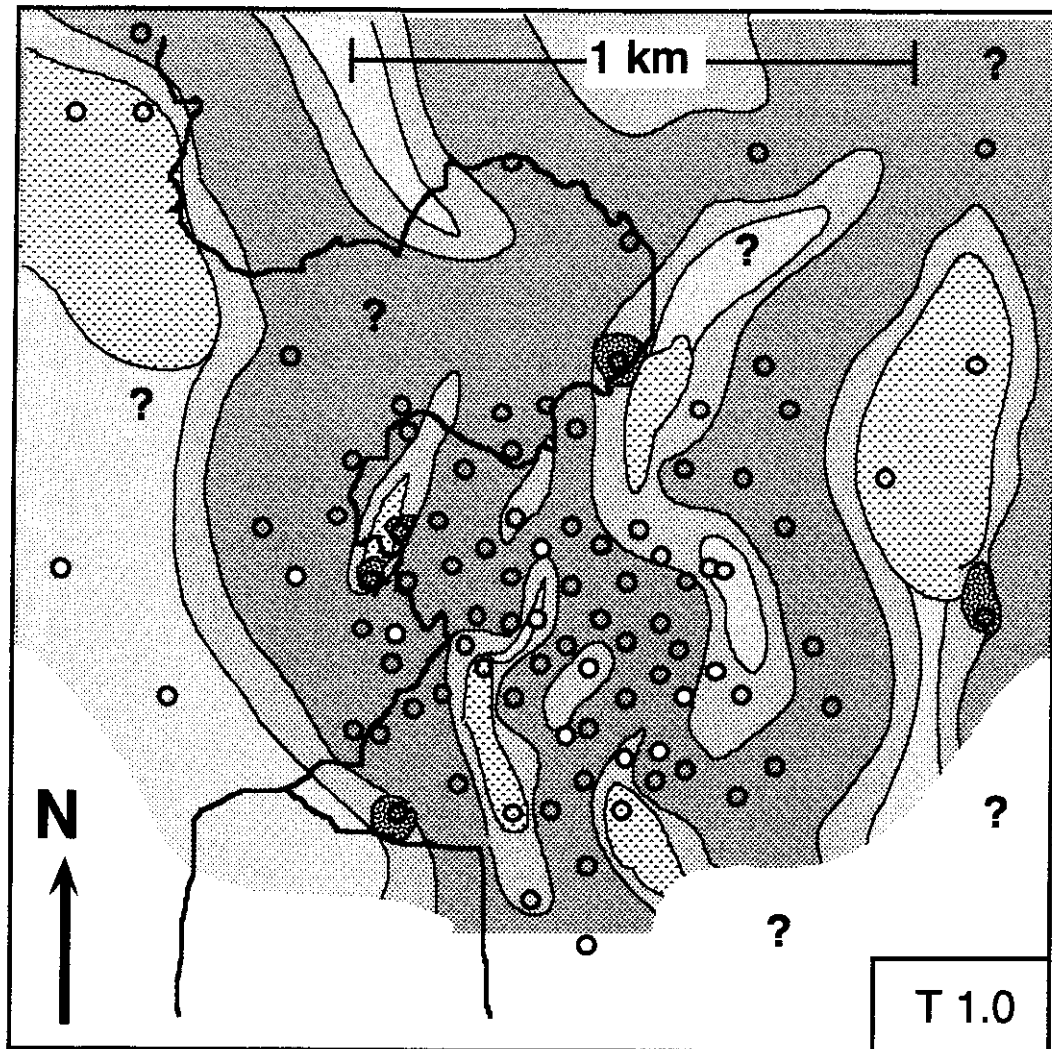


Figure 17. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

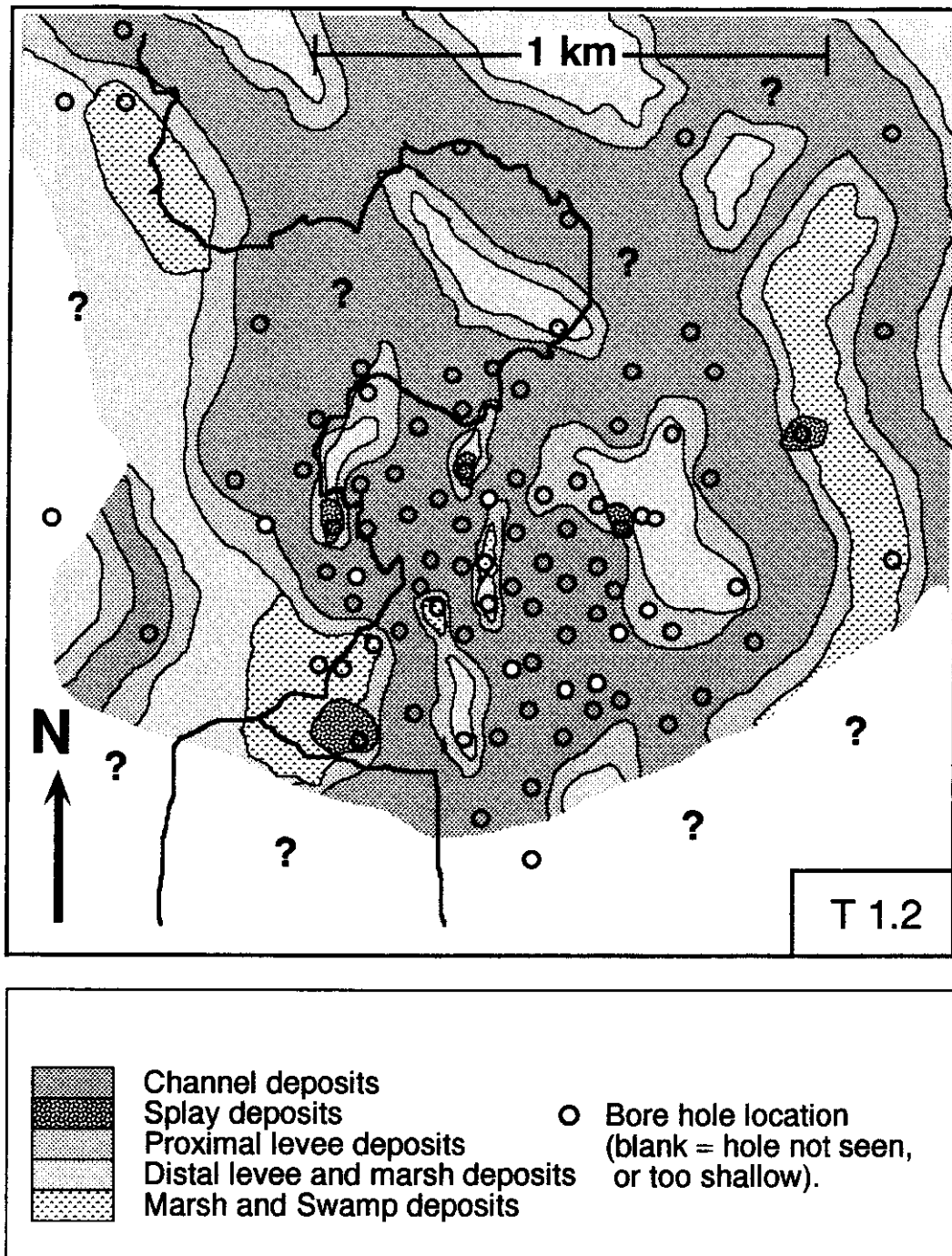


Figure 18. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

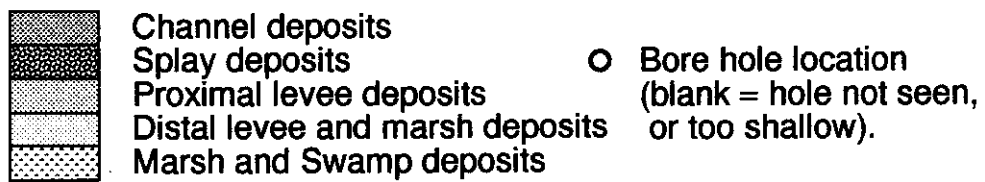
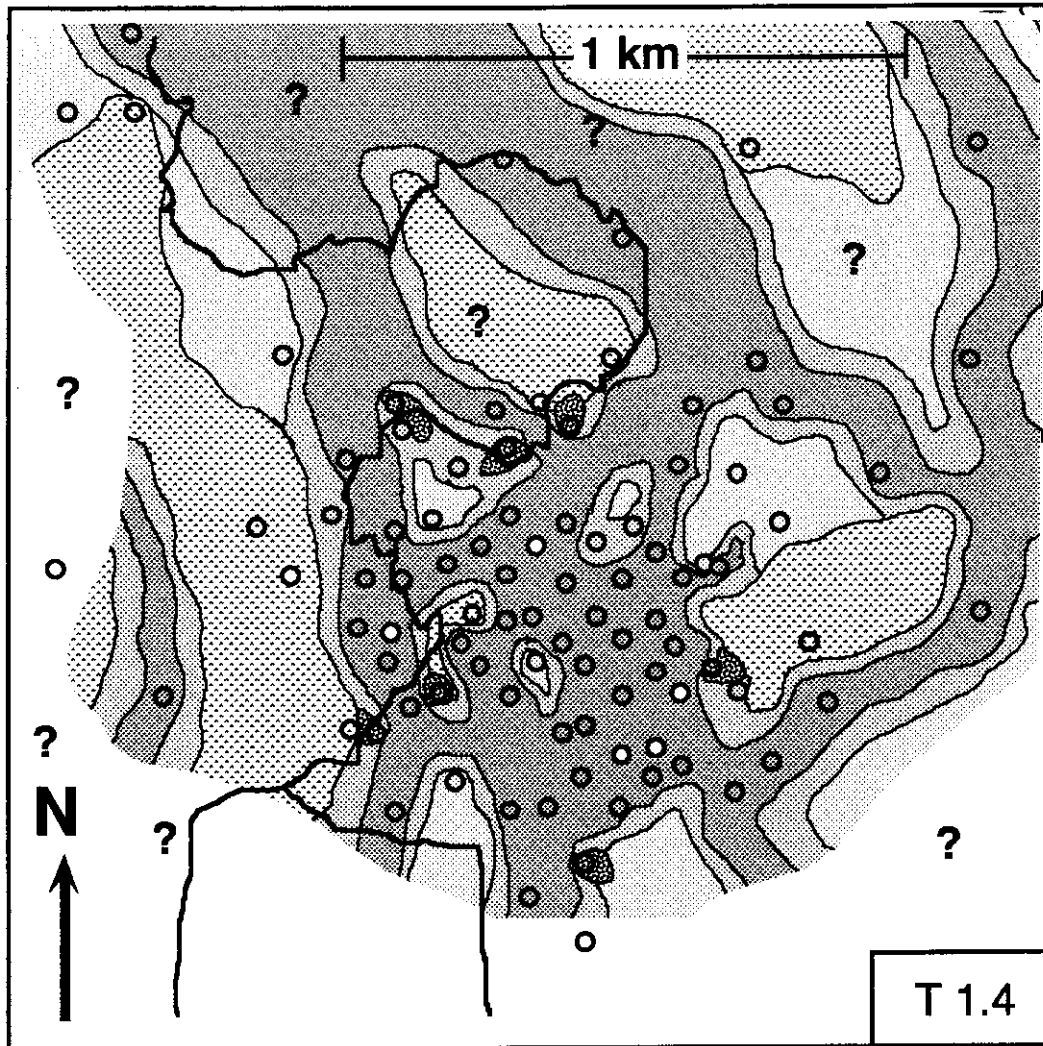


Figure 19. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

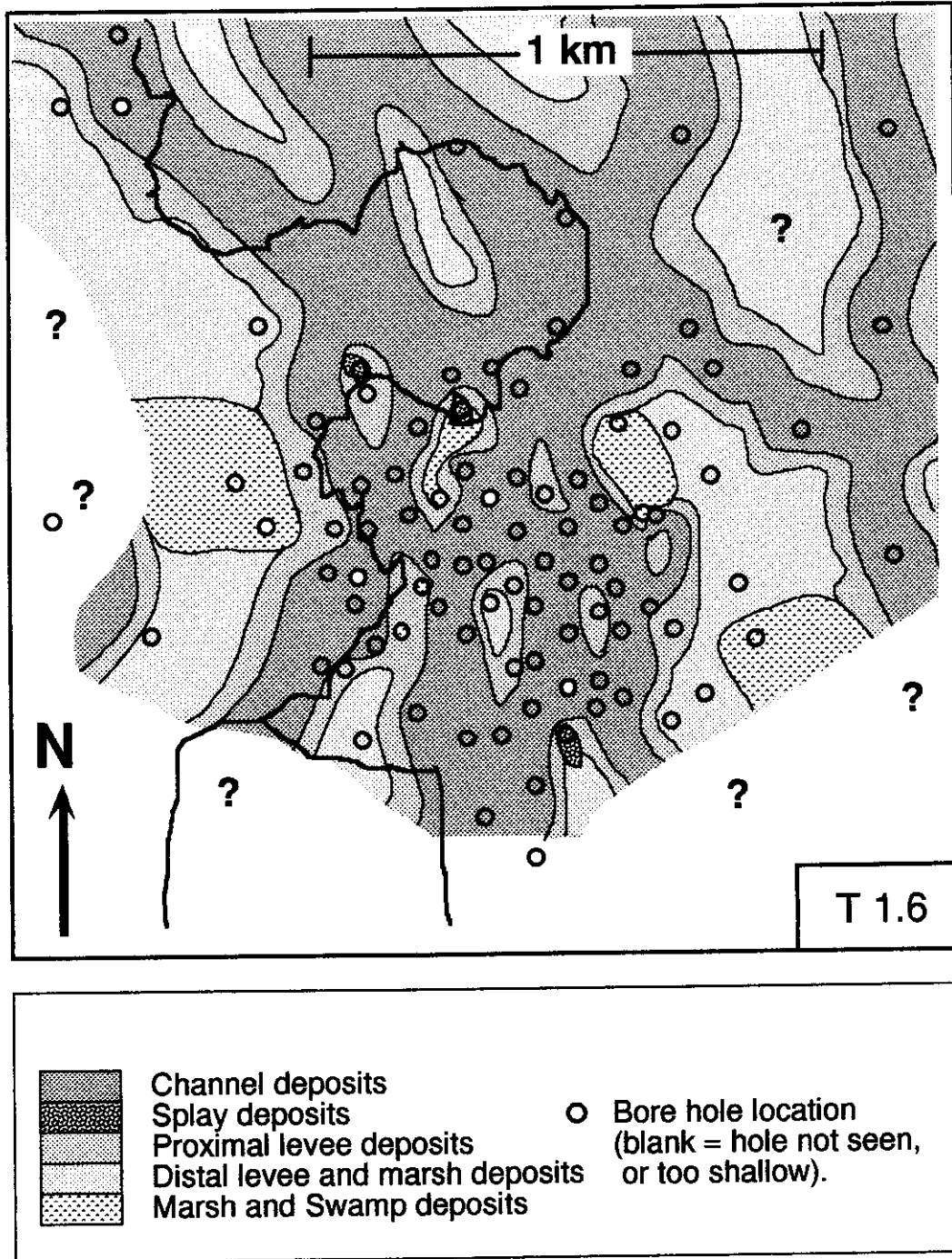


Figure 20. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

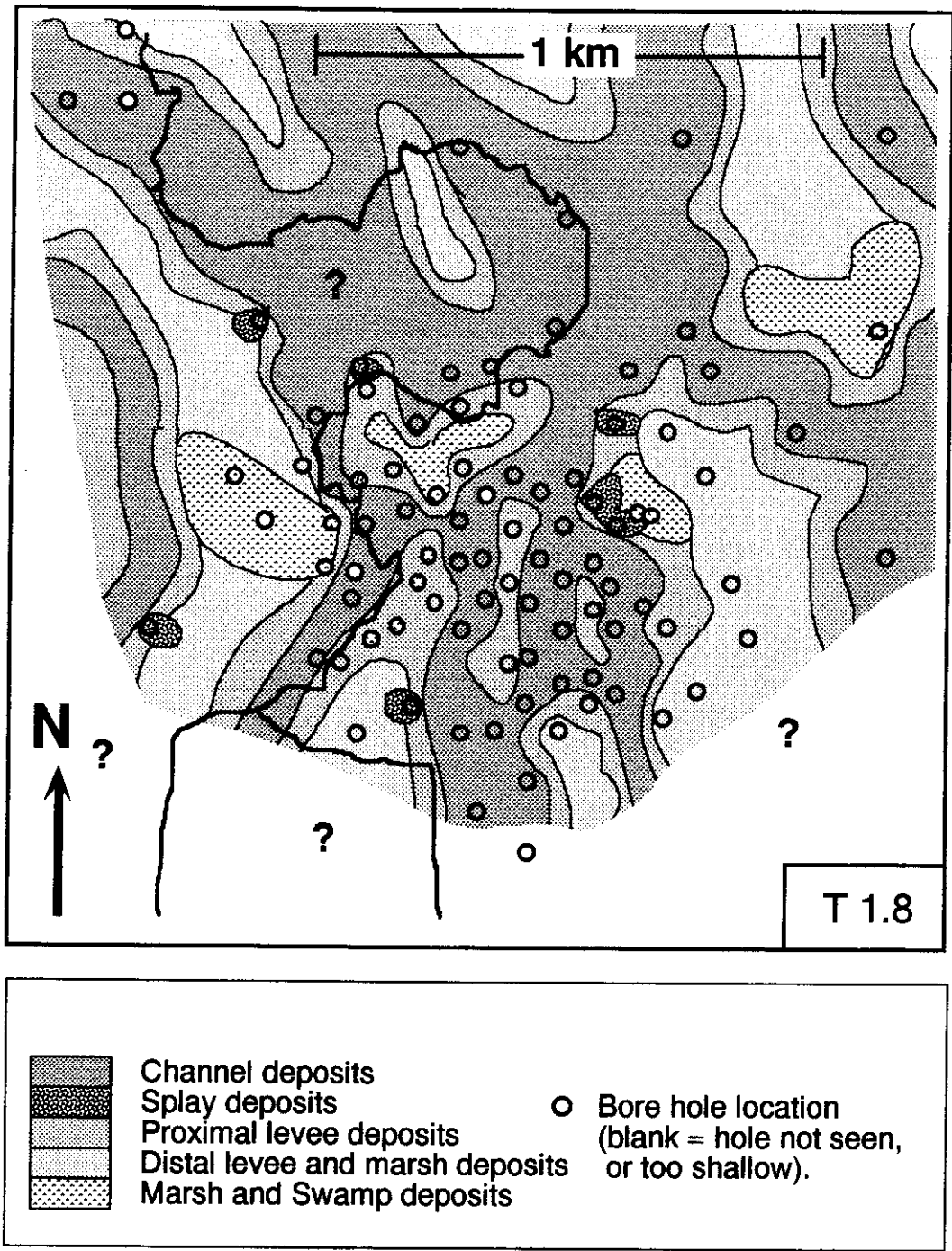


Figure 21. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

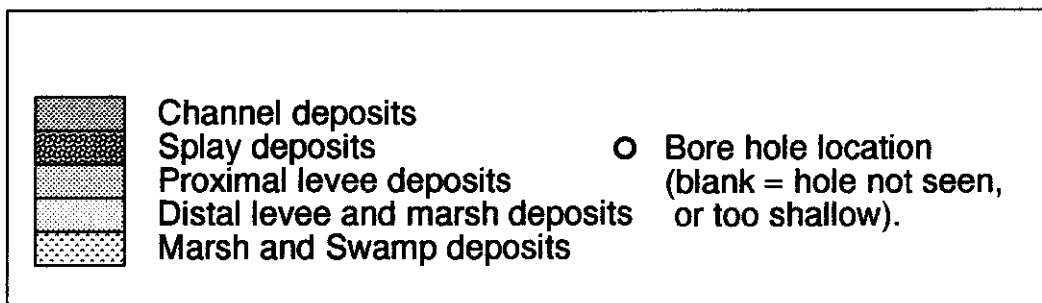
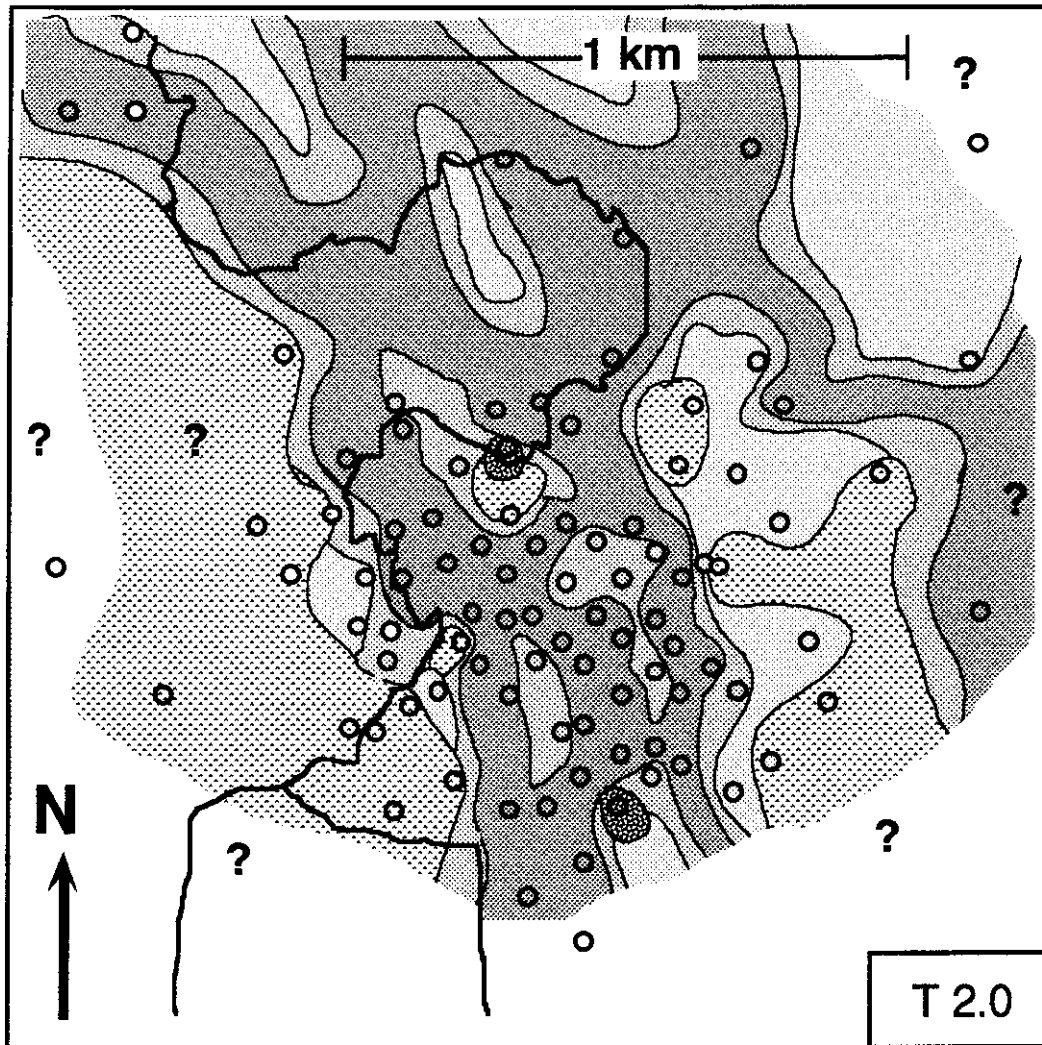


Figure 22. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

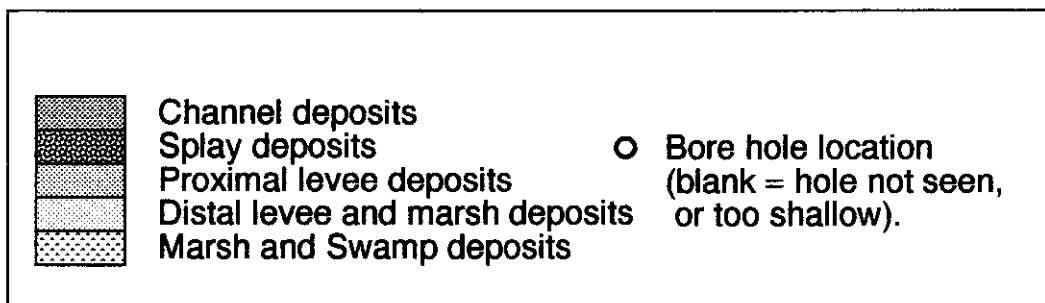
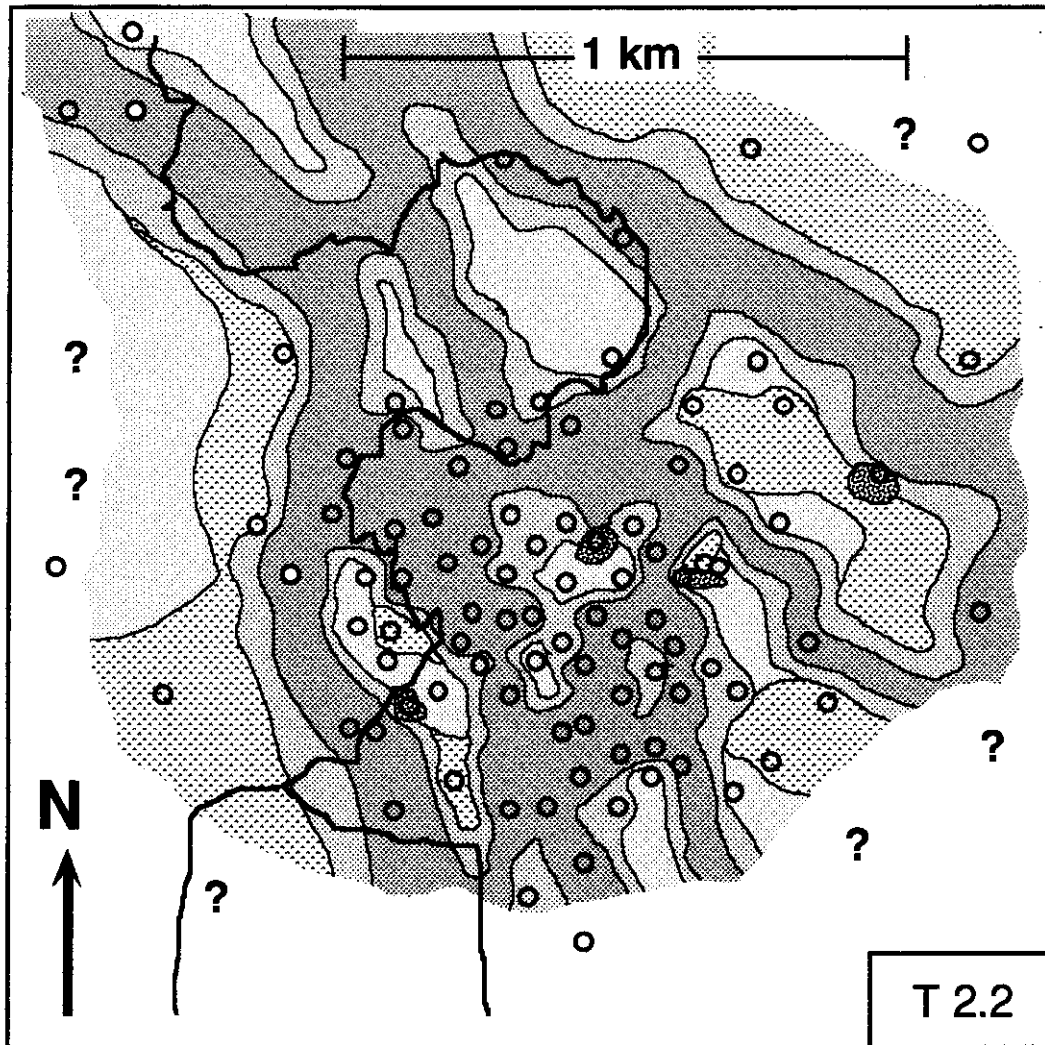


Figure 23. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

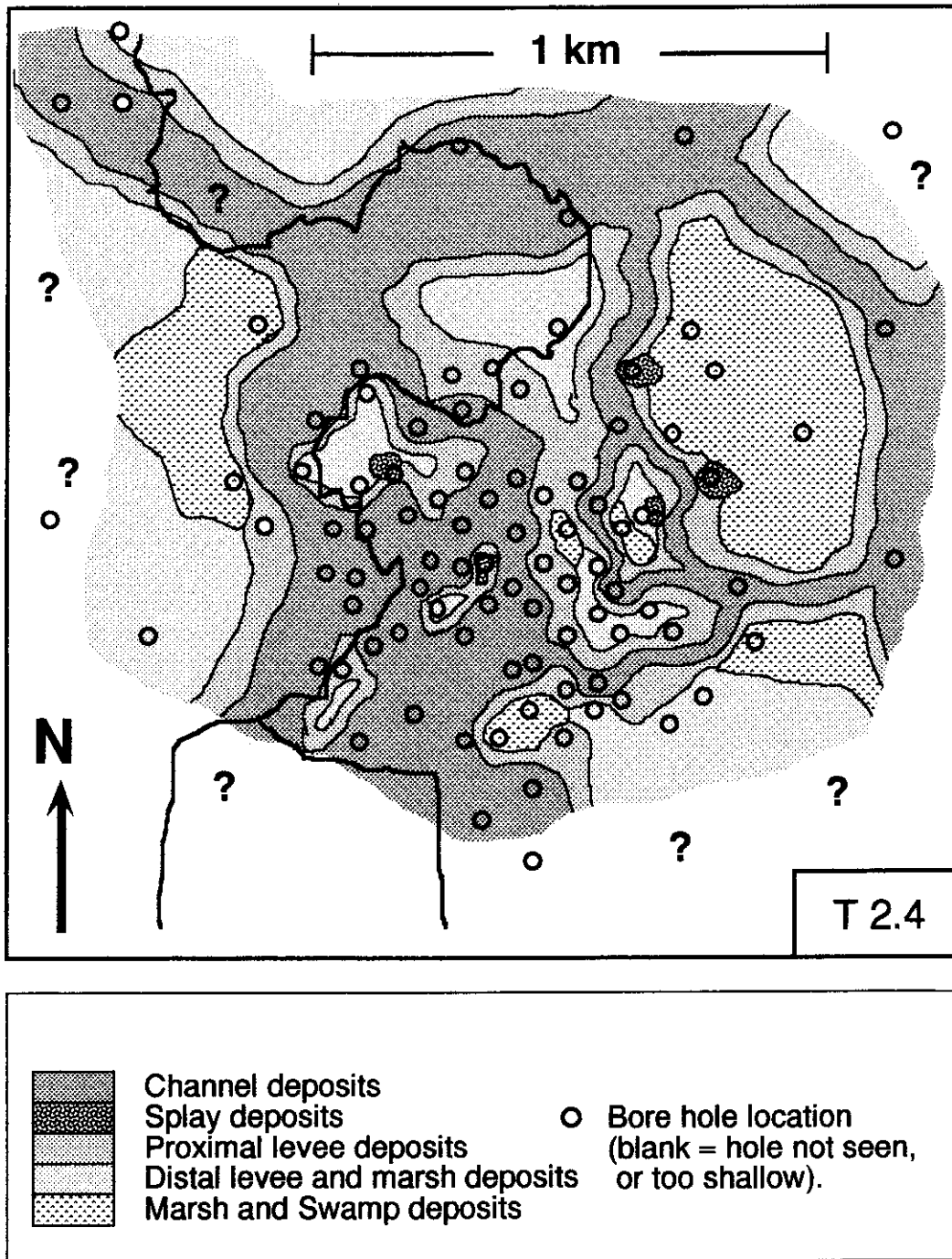


Figure 24. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

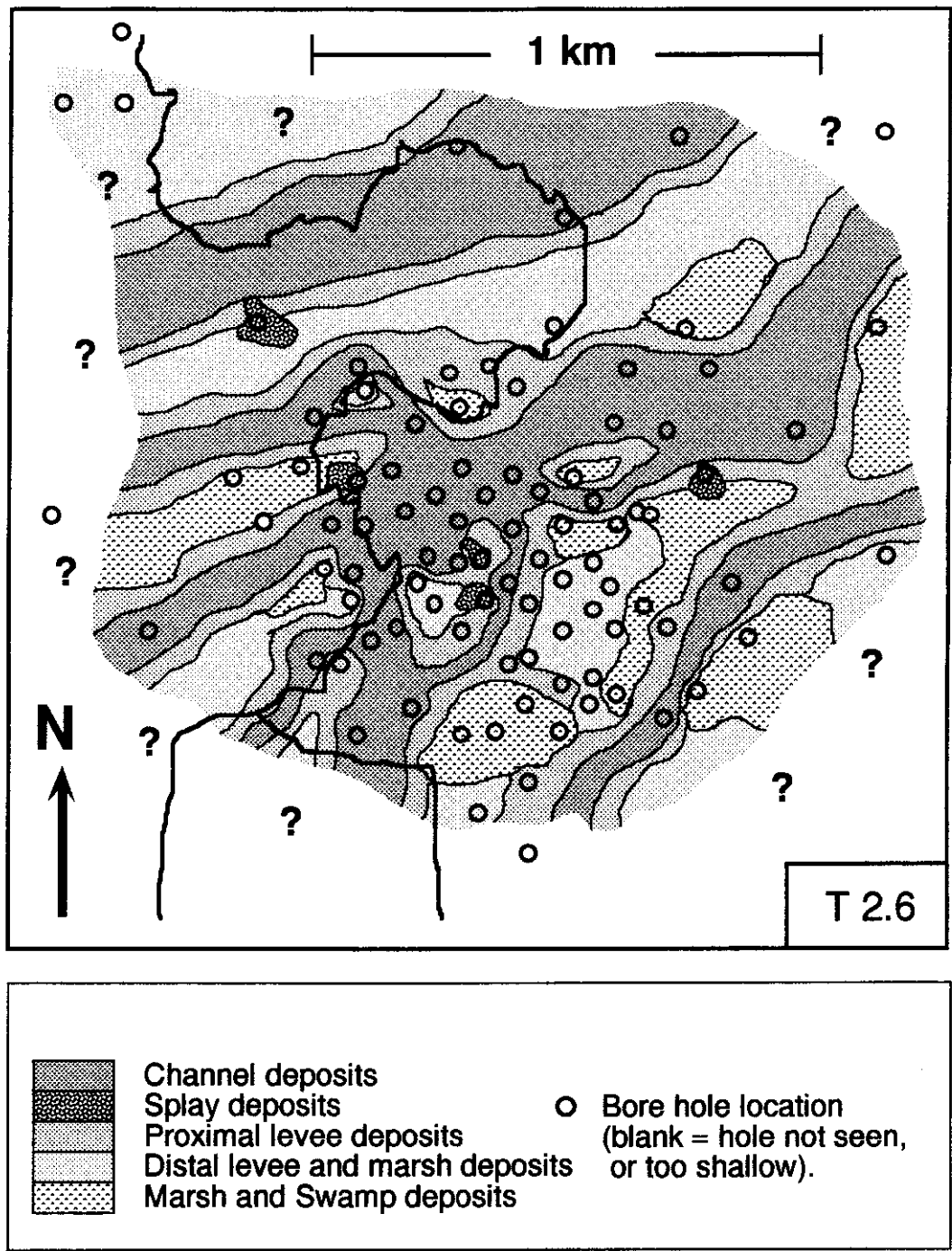


Figure 25. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

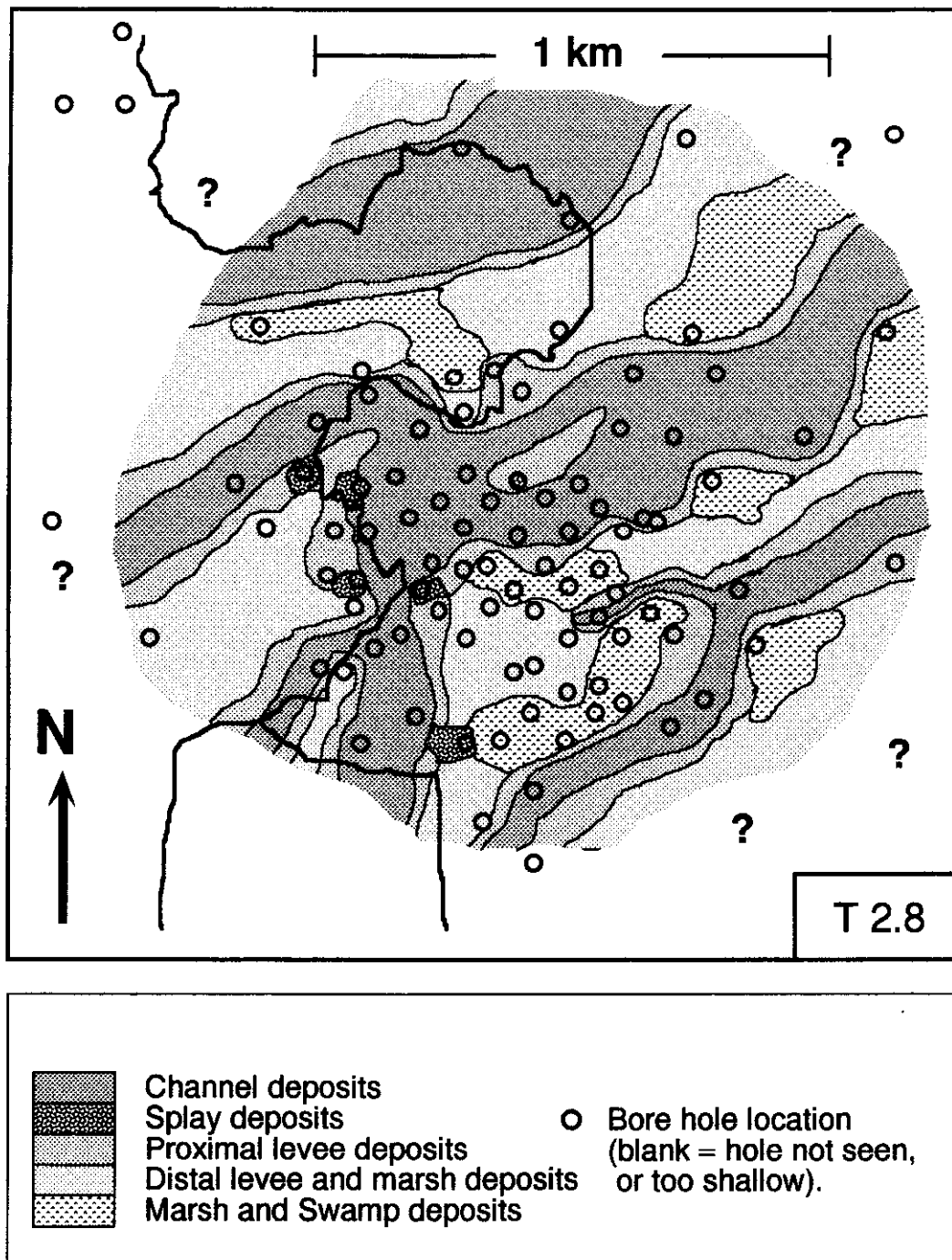


Figure 26. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

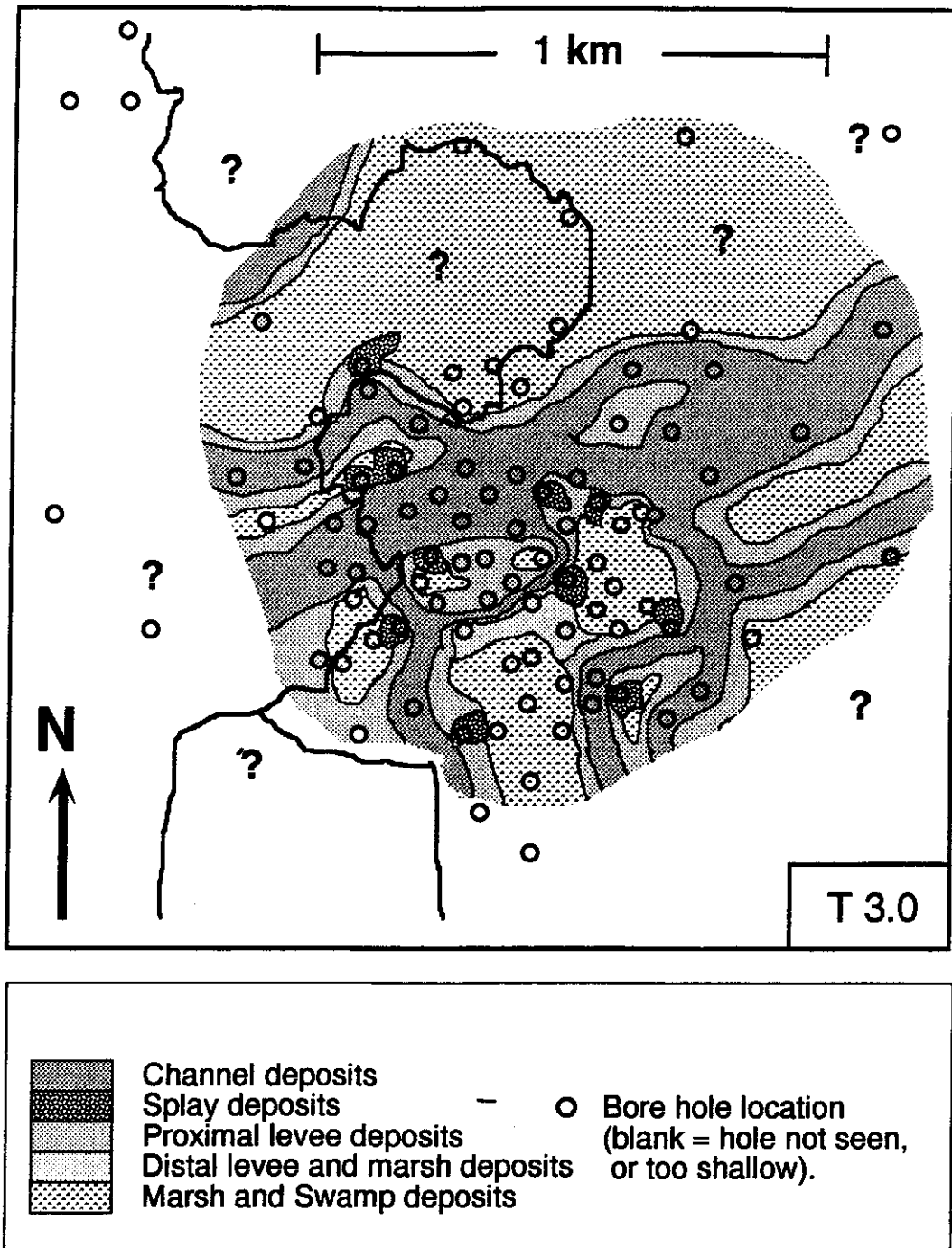


Figure 27. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

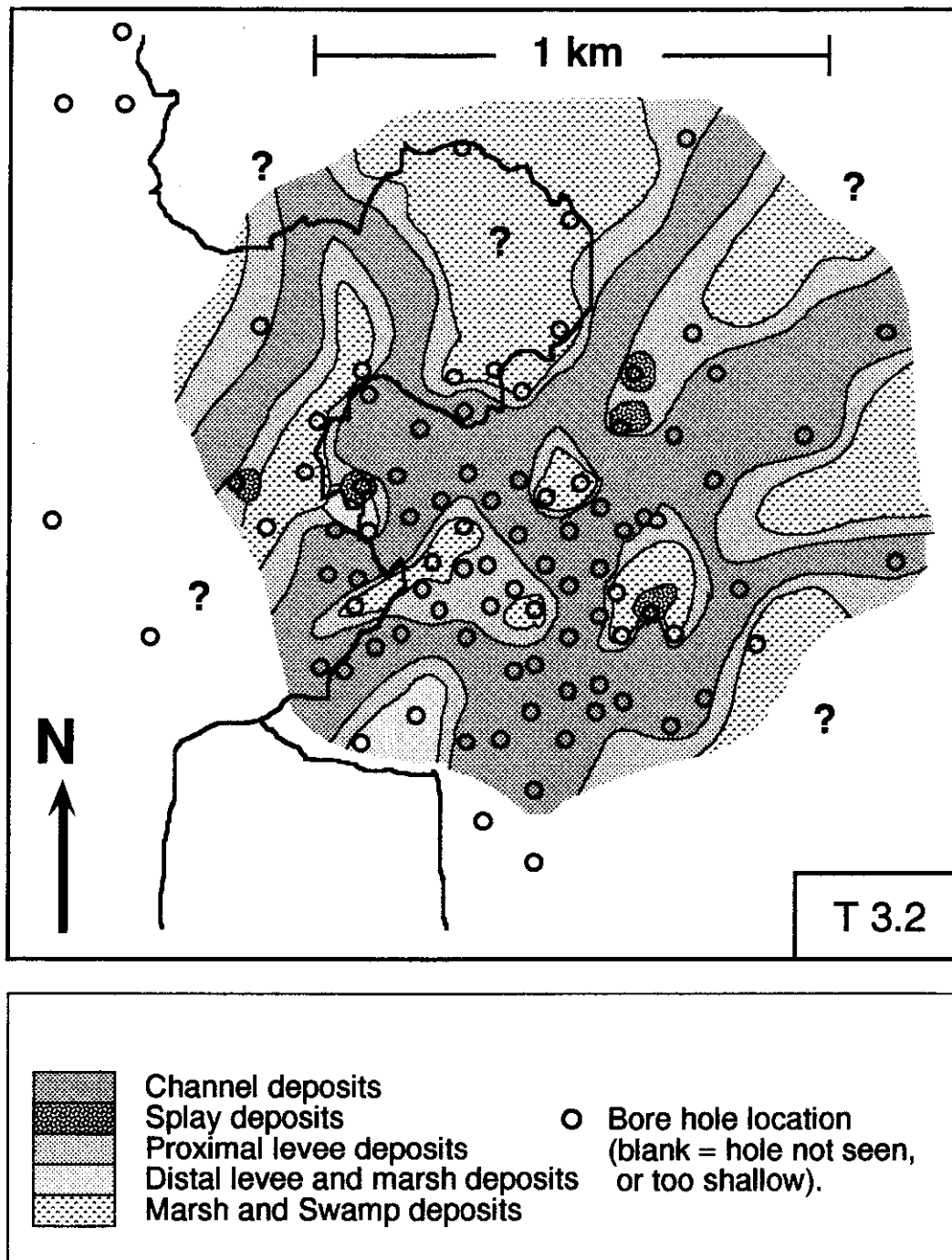


Figure 28. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

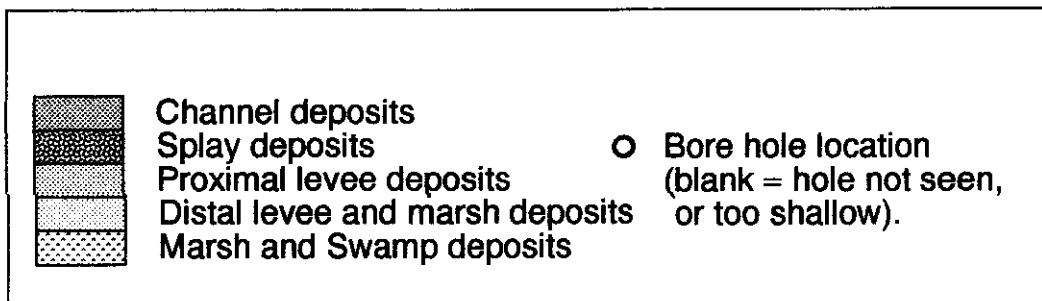
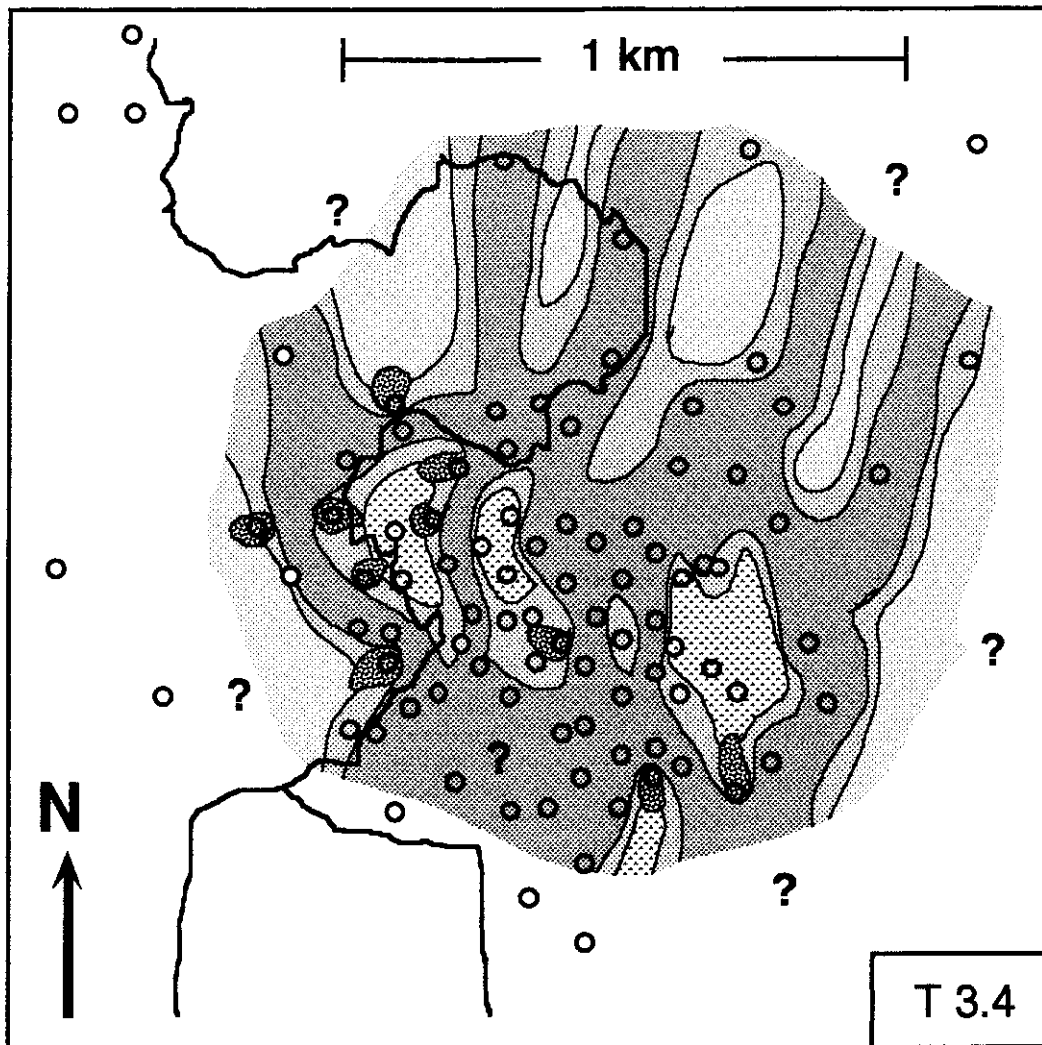


Figure 29. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

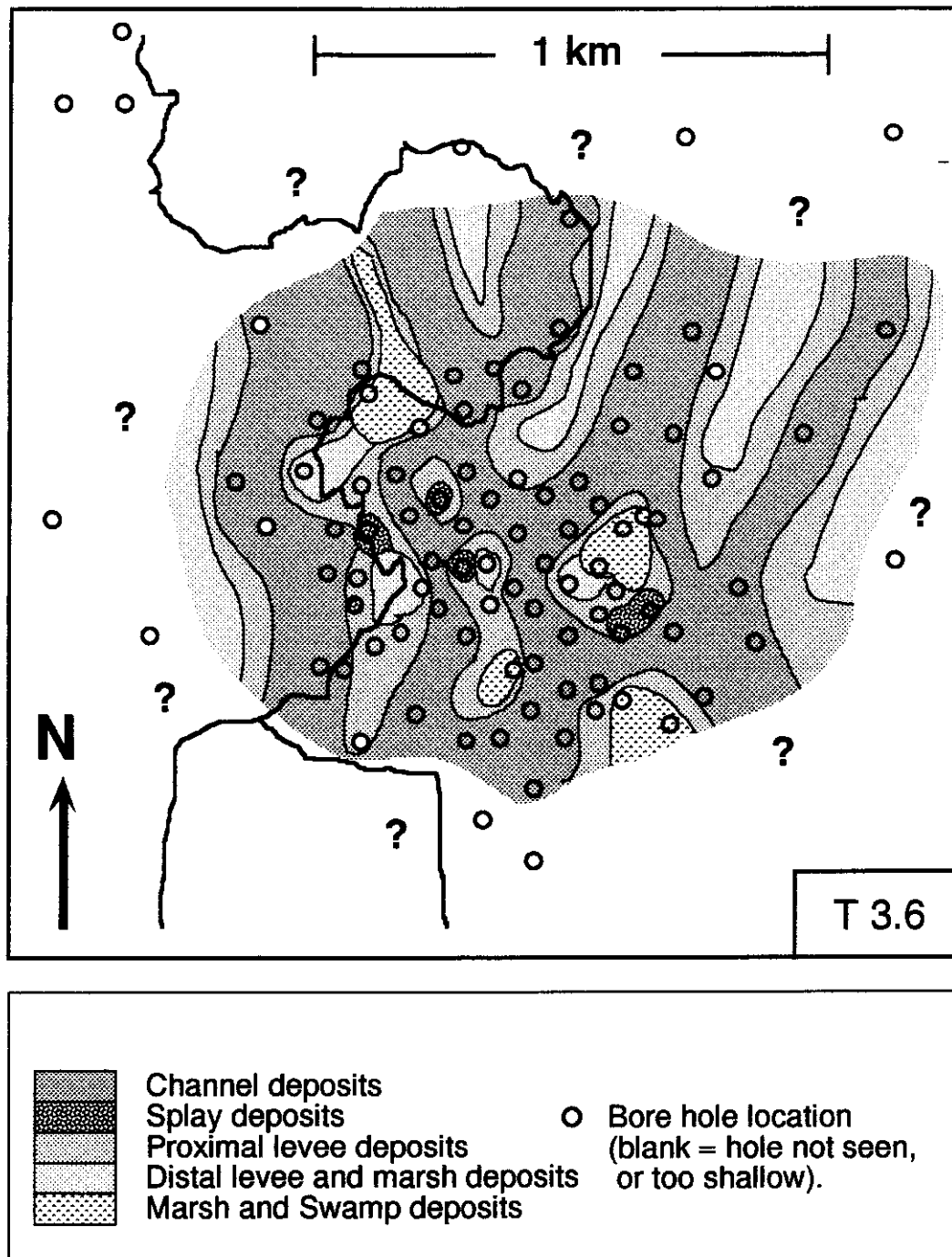


Figure 30. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

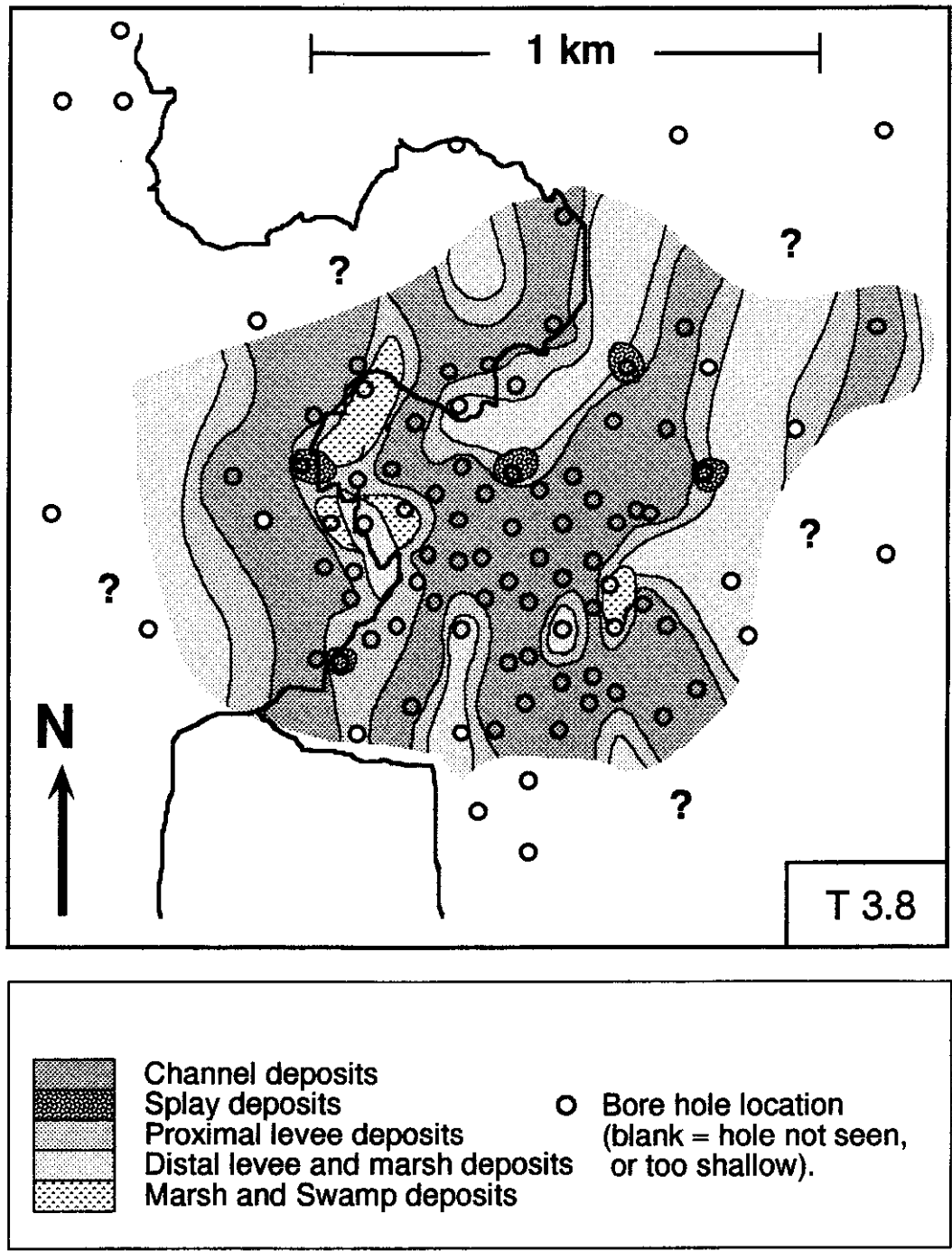


Figure 31. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

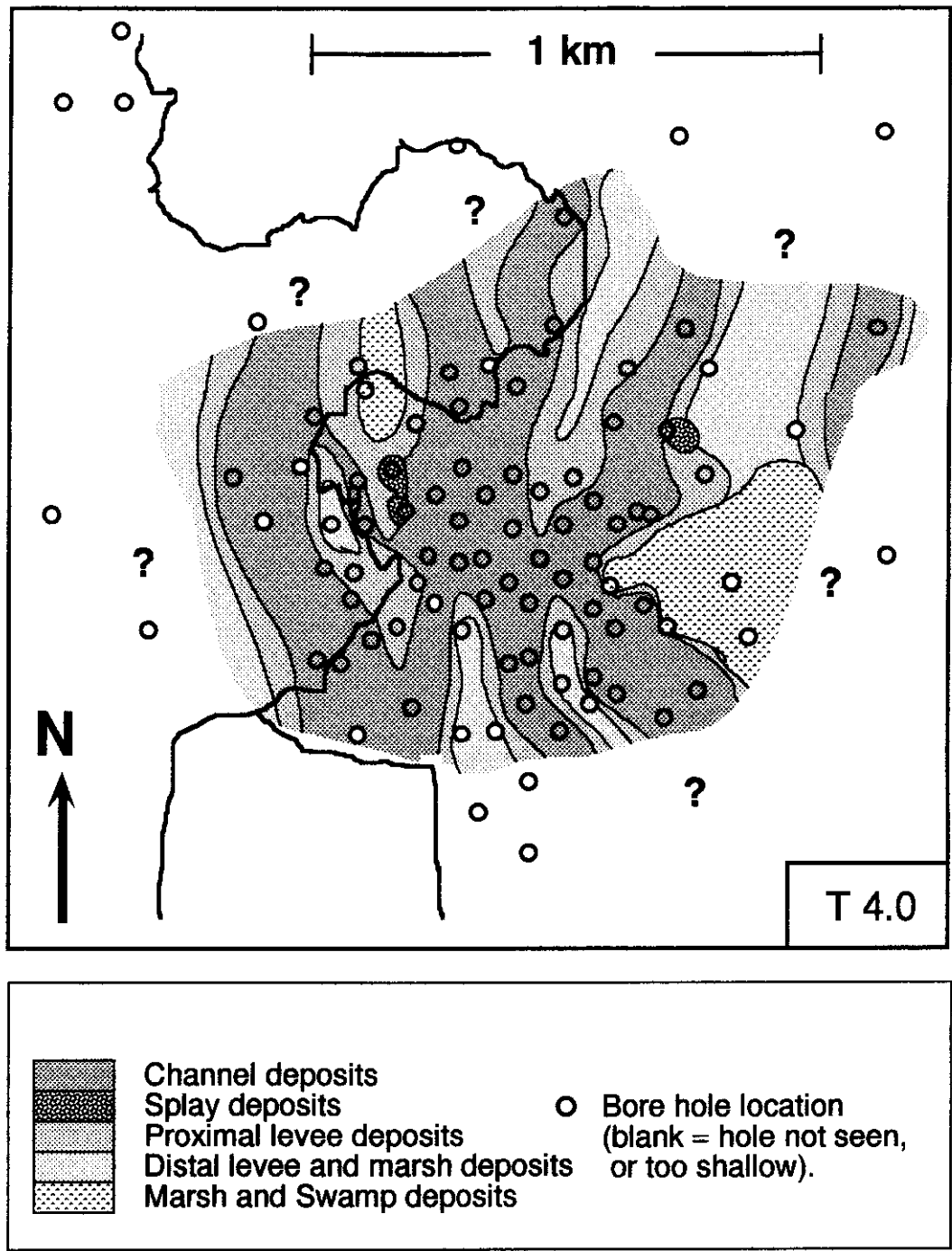


Figure 32. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

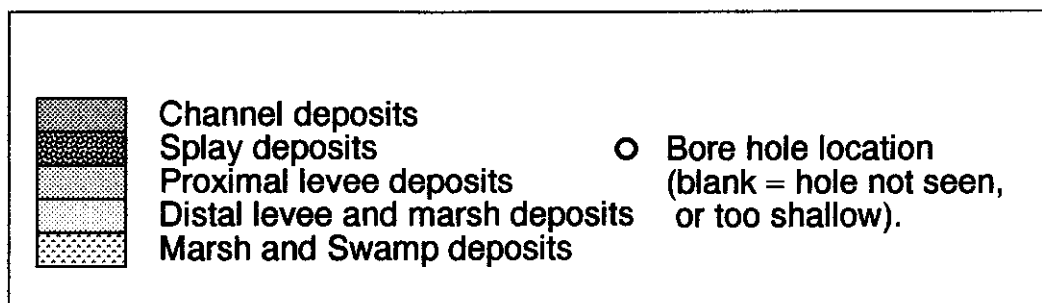
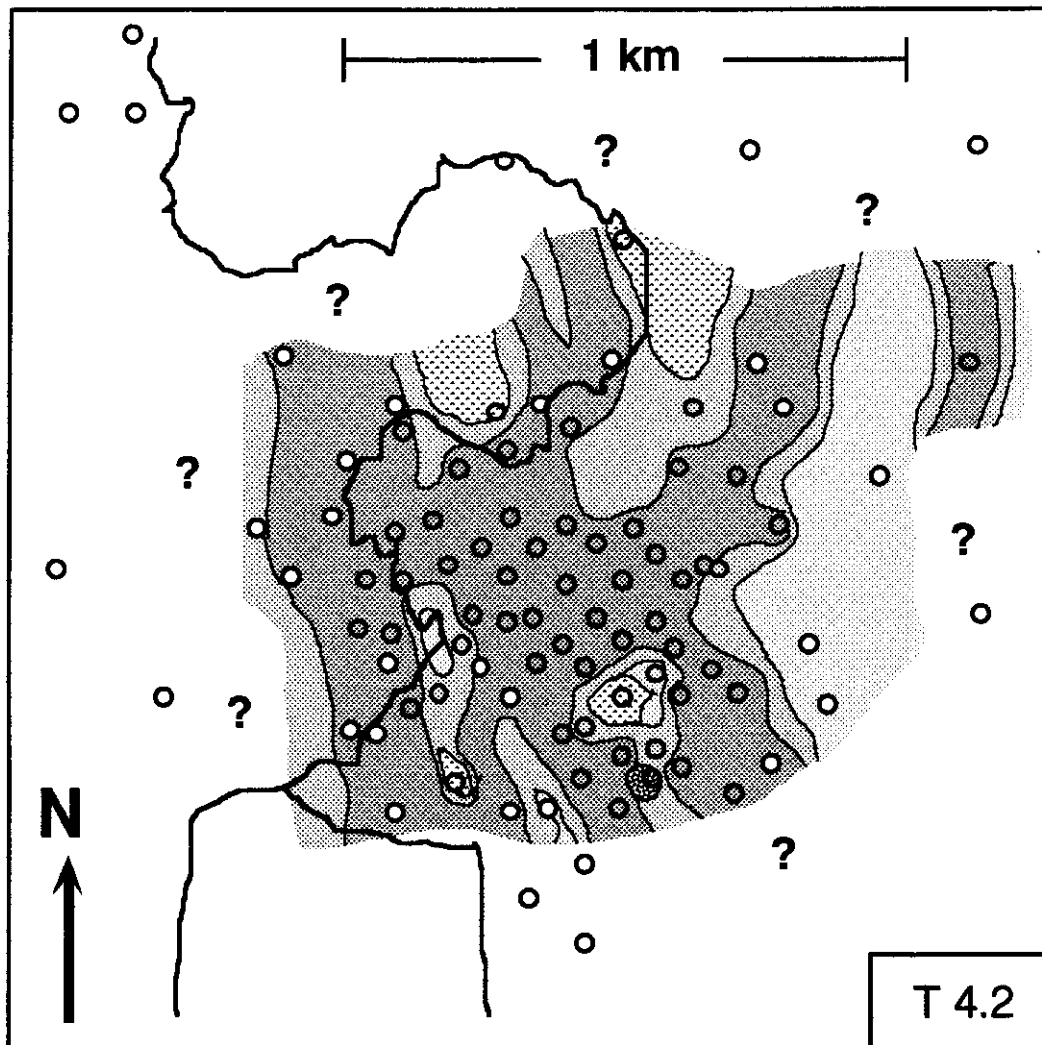


Figure 33. Paleogeographic reconstruction of the central part of the Pike Creek area (Figure 3).

Grey and grey to dark brown mudstones (Lithofacies 5) are slightly more abundant (especially in the lower parts of some of the holes), suggesting marsh environments with the water table at or near the surface during part of the year. The presence of abundant slickensides in these "ball clays" and in lighter coloured mudstones (Lithofacies 6) is usually taken to be associated with a fluctuating water table (Try et al. 1984). In dry periods the soil shrank and cracked, to swell again in wet periods. Rubbing of adjacent soil crumb and blocks during repeated wetting and drying led to the production of grooved and polished surfaces, now represented by the slickensides (Donahue et al. 1958; Fitzpatrick 1980). Periodic drying is also indicated by local "mottled" colour patterns (patches of red and pink) in the grey mudstones (Fitzpatrick 1980; Try 1984).

White, yellow, light brown and red mudrocks (Lithofacies 6) are interpreted as floodplain meadow and ephemeral pond deposits which accumulated in areas where the water table was periodically lowered to such a level that most of the organic material was removed by oxidation. Typically slickensides are well developed, indicating repetitive wetting and drying cycles. In some samples, especially in the red and yellow varieties, ped textures are outlined by thin laminae of clay which was washed into place during eluviation of the soils. The red and yellow colours of some of the mudstones are indicative of soil development in tropical to sub-tropical settings (Fitzpatrick 1980). These colours are probably the result of oxidation of iron minerals under strongly aerobic conditions; together with the presence of abundant kaolin and minor gibbsite (Fyfe et al. 1983; Murray et al. 1984) they indicate soil formation under intense weathering conditions, analogous to those found in the modern Amazon and Niger Basins (Brown et al. 1986).

Laminated mudstones (Lithofacies 7) are a minor component of the strata preserved in the Pike Creek area. They are interpreted as the products of deposition in small ponds and lakes on the floodplain surface. Minor colour variations may reflect seasonal or temporal variations in the character of sediment input, or biogenic

activity (Try et al. 1984).

Paleogeographic reconstructions of the Pike Creek Area (*see* Figures 11 to 33) suggest that mudstones accumulated in lozenge shaped bodies away from the channels. In the Pike Creek area these areas of floodplain-marsh environments ranged from as little as 600 m² to over 50,000 m², with maximum elongation parallel to mean local channel flow directions.

The abundance of channel deposits in the Pike Creek area is comparable to the upper third of Lignasco bore hole J-1-1 and Ontario Geological Survey bore hole 78-1 (Try 1984), both of which are located in the central-eastern part of Kipling Township. Norris and Zippi's (1991) have placed this interval in the upper part of the Mattagami Formation, in their concurrent range zone (Zone 6), which they consider to be of late Middle Albian to Late Albian age.

STATISTICAL RELATIONSHIPS

Quartz is the most abundant identifiable component of the Mattagami Formation in the Pike Creek area. Kaolin forms an average of 10.3% of 480 samples analyzed, with a range of 1.2 to 82.5 %. Fe₂O₃ forms on average 0.97% (390 analysis) with a range of 0 to 20.1%. TiO₂ (average = 0.41%: range 0 to 1.94%) and P₂O₅ (average 0.05%: range 0 to 0.15%) form minor components (390 analysis). Zirconium and barium are present in trace quantities (Average Zr = 90 ppm: range 0 to 631 ppm; Average Ba = 54 ppm: range 0 to 329 ppm; 199 analysis).

A statistical analysis of the relations between grain size and facies of the holes logged in detail, and analytical data provided by Minerals Research Canada is summarised in Tables 2 and 3 and Figures 34 to 40. Further details are provided below.

Direct statistical comparison of the median grain size of samples from the

Mattagami Formation with chemical analysis and brightness data provided by Minerals Research Canada indicates a progressive increase in kaolin content with decrease in median grain size (see Table 2; Figure 34), such that:

$$\% \text{ Kaolin} = 8.60 + 5.83 \Phi$$

Where Φ (PHI) is the grain size expressed as the negative log, base 2, of the grain size in millimetres (Folk 1968). This has a correlation coefficient (R) of 84%. TiO_2 shows a similar trend (R = 83%), as do to a lesser extent Fe_2O_3 (R = 41%), P_2O_5 (R = 39%), Zr (R = 63%) and Ba (64%) (Table 2 and Figures 34, 35, 36). G.E brightness of clays in the less than 325 mesh fraction appears to increase slightly with increased grain size, but the correlation between grain size and brightness is low (R = 37%: see Table 2 and Figure 37).

An alternate method of comparison of lithology with chemical properties can be made by examining the average composition of individual lithofacies (Table 3 and Figures 34 to 40). Due to inherent stratigraphic bias in the data only 6 lithofacies can be considered as too few analysis exist for coals and laminated mudrocks for these to be treated statistically.

Kaolin content appears to lowest in channel, splay and levee facies, and highest in floodplain facies (Figure 38 upper). The moderate to low levels of kaolin in the channel, levee and splay facies is thought to represent *in situ* diagenetic alteration of detrital feldspars under acid - oxidising groundwater conditions (Try et al. 1984; Long 1991) rather than a high primary clay content. The average kaolin content is marginally higher in grey mudrocks (lithofacies 5) than swamp (lithofacies 4) and oxidised floodplain-marsh deposits, although there is considerable overlap in the compositional range (see Table 3). The lower average kaolin content of the swamp facies may reflect the presence of other clay minerals, such as illite, in these organic rich mudrocks.

Table 2. Grain size versus chemistry and G.E. brightness of samples from the Mattagami Formation.

% Kaolin	=	8.601 + 5.830 O;	R = 84%
% Fe ₂ O ₃	=	0.537 + 0.204 O;	R = 41%
% TiO ₂	=	0.183 + 0.106 O;	R = 83%
% P ₂ O ₅	=	0.041 + 0.004 O;	R = 39%
Zr (ppm)	=	94.75 + 20.50 O;	R = 63%
Ba (ppm)	=	49.58 + 11.02 O;	R = 64%
G.E. brightness	=	73.98 - 0.89 O;	R = 37%

O = negative log, base 2 of size in millimetres

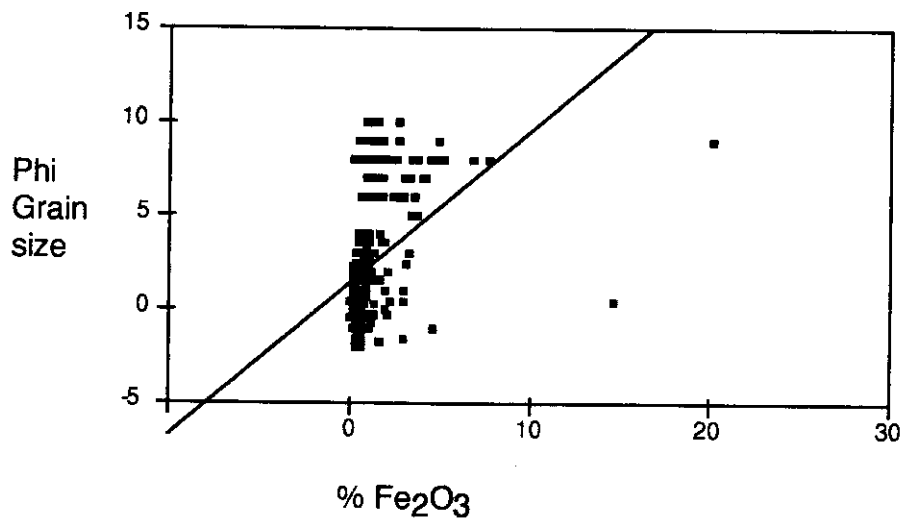
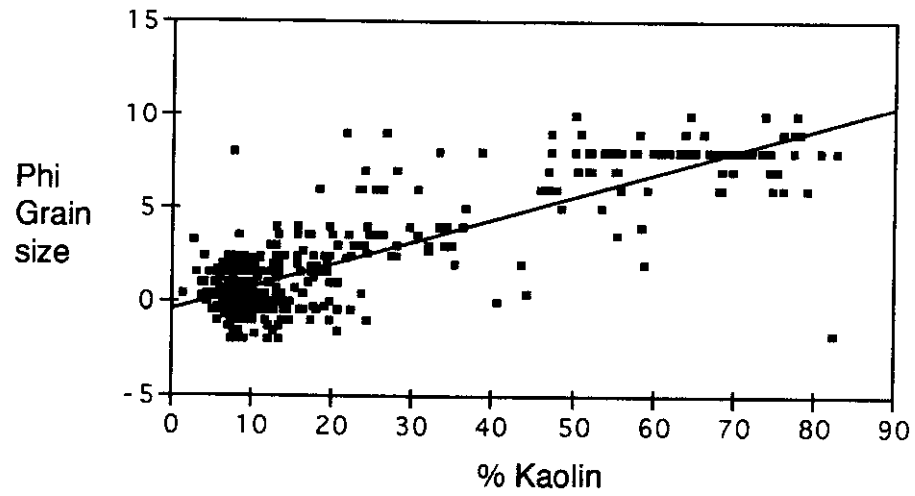


Figure 34. a) Grain size versus kaolin content of strata in the Mattagami Formation,
 b) Grain size versus Fe_2O_3 content of strata in the Mattagami Formation.

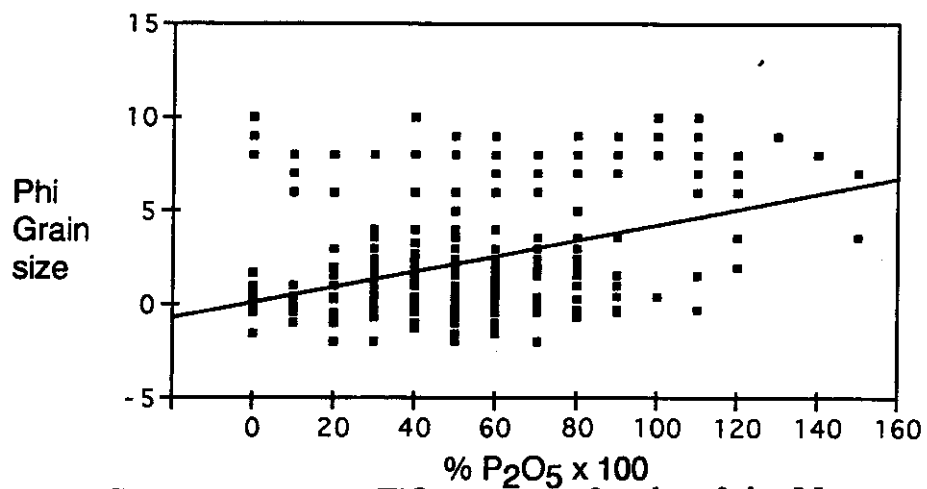
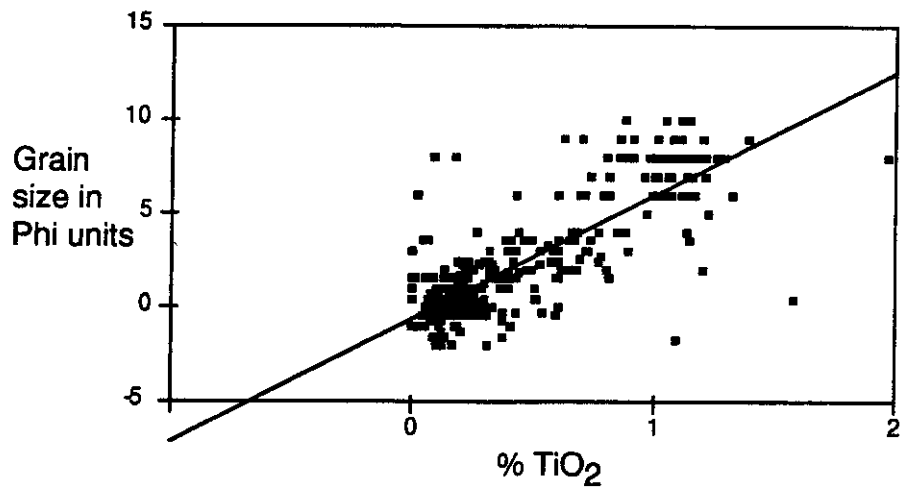


Figure 35. a) Grain size versus TiO₂ content of rocks of the Mattagami Formation, b) Grain size versus P₂O₅ content of strata in the Mattagami Formation.

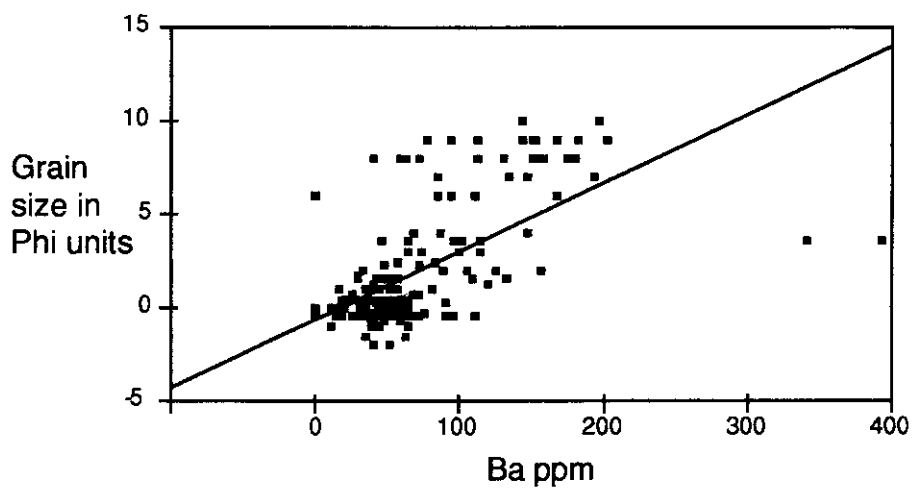
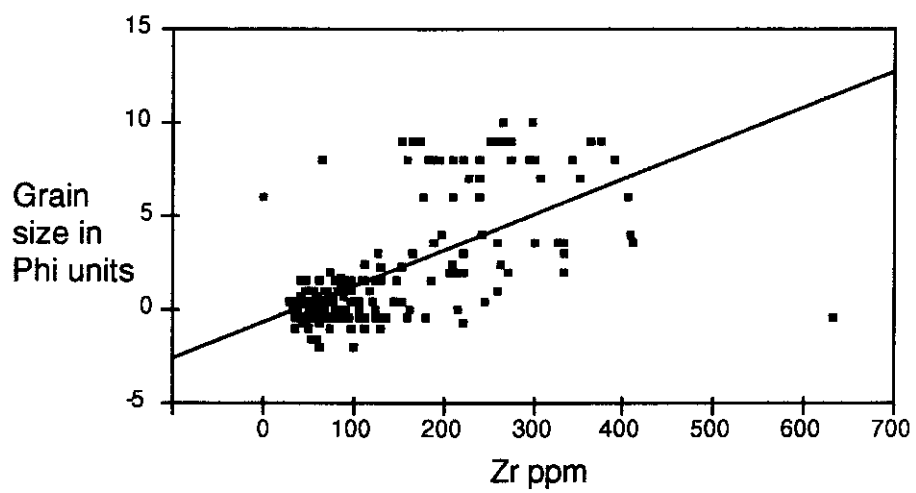


Figure 36. a) Grain size versus Zr content (ppm) b) Grain size versus Ba content (ppm).

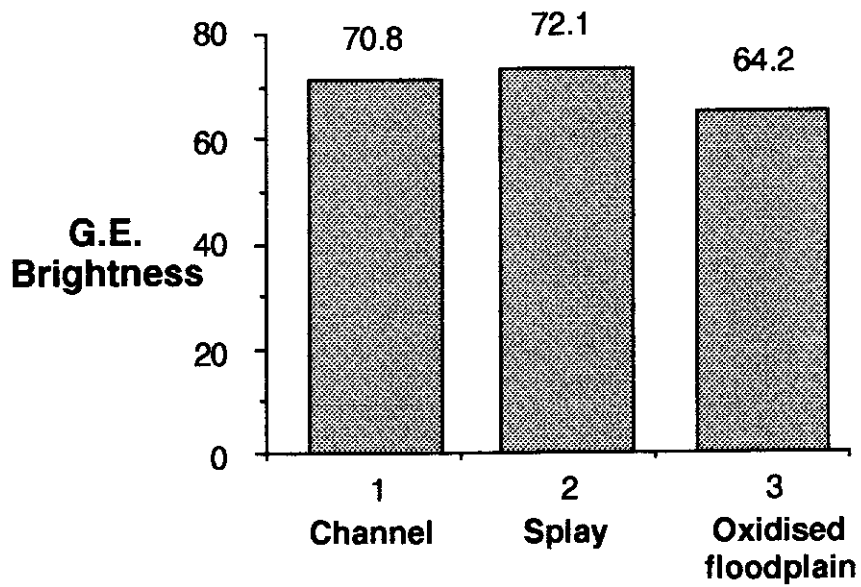
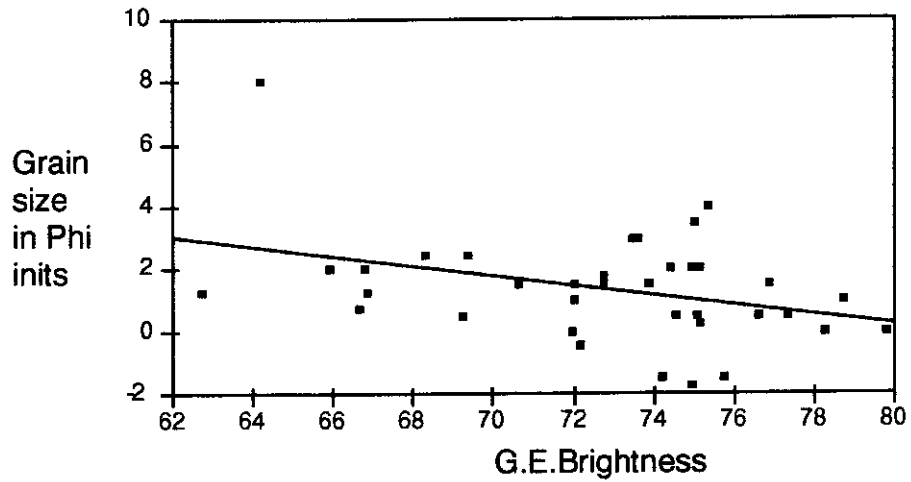


Figure 37. a) Grain size versus G.E. Brightness, b) Facies versus G.E. Brightness.

Table 3. Lithofacies and chemistry: average \pm standard deviation (range)

Facies	Channel 1	Splay 2a	Levee 2b	Swamp 4	Marsh 5	Oxidised Marsh 6
Kaolin	9.4 \pm 3.8	14.4 \pm 14.5	14.1 \pm 8.7	46.8 \pm 8.7	60.2 \pm 15.4	56.3 \pm 17.8
%	(1.2-44.0)	(5.0-58.5)	(2.7-55.5)	(38.4-55.7)*	(7.6-80.6)	(18.4-82.5)
Fe ₂ O ₃	0.6 \pm 1.2	0.7 \pm 0.6	0.7 \pm 0.5	1.2 \pm 0.2	2.5 \pm 1.8	2.2 \pm 2.9
%	(0.0-14.7)	(0.2-2.0)	(0.1-0.3)	(1.1-1.4)*	(0.5-7.6)	(0.2-20.1)
TiO ₂	0.16 \pm 0.13	0.34 \pm 0.33	0.41 \pm 0.24	0.98 \pm 0.20	1.06 \pm 0.23	0.98 \pm 0.31
%	(0.03-1.58)	(0.1-1.2)	(0.0-1.15)	(0.82-1.21)*	(0.09-1.29)	(0.02-1.97)
P ₂ O ₅	0.04 \pm 0.02	0.05 \pm 0.03	0.05 \pm 0.03	0.05 \pm 0.03	0.05 \pm 0.03	0.07 \pm 0.04
%	(0.0-0.09)	(0.01-0.12)	(0.03-0.15)	(0.03-0.09)*	(0.00-0.11)	(0.00-0.15)
Zr	81 \pm 66	120 \pm 110	179 \pm 107	no data	269 \pm 42	239 \pm 18
ppm	(30-631)	(34-334)*	(41-411)		(210-300)*	(0-202)
Ba	46 \pm 21	59 \pm 58	92 \pm 88	no data	168 \pm 23	127 \pm 53
ppm	(0-120)	(0-156)	(30-392)		(144-197)*	(0-202)
G.E.	73.6 \pm 4.4	no data	72.1 \pm 3.3	no data	no data	64.2*
Brightness	(62.7-79.8)		(65.5-75.2)			

* = less than seven analysis.

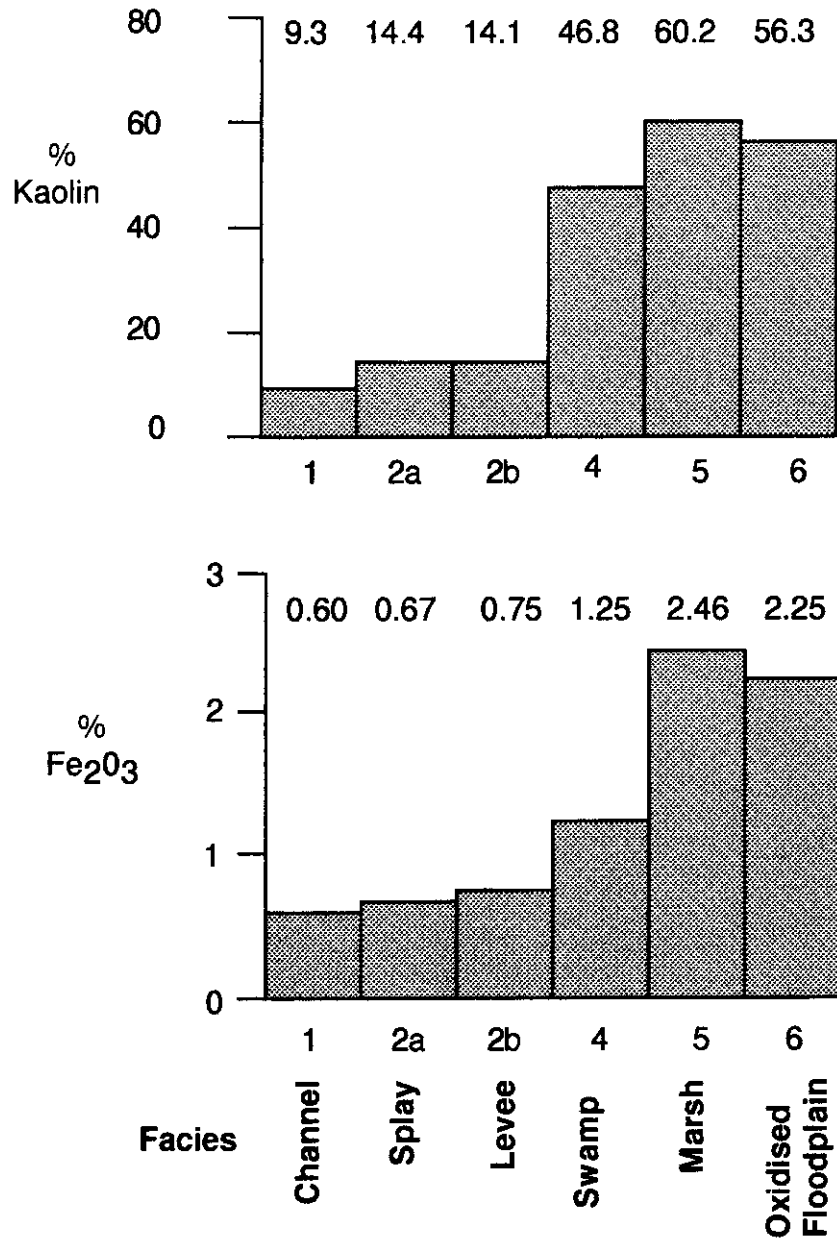


Figure 38. a) Facies versus average kaolin content, b) Facies versus Fe₂O₃.

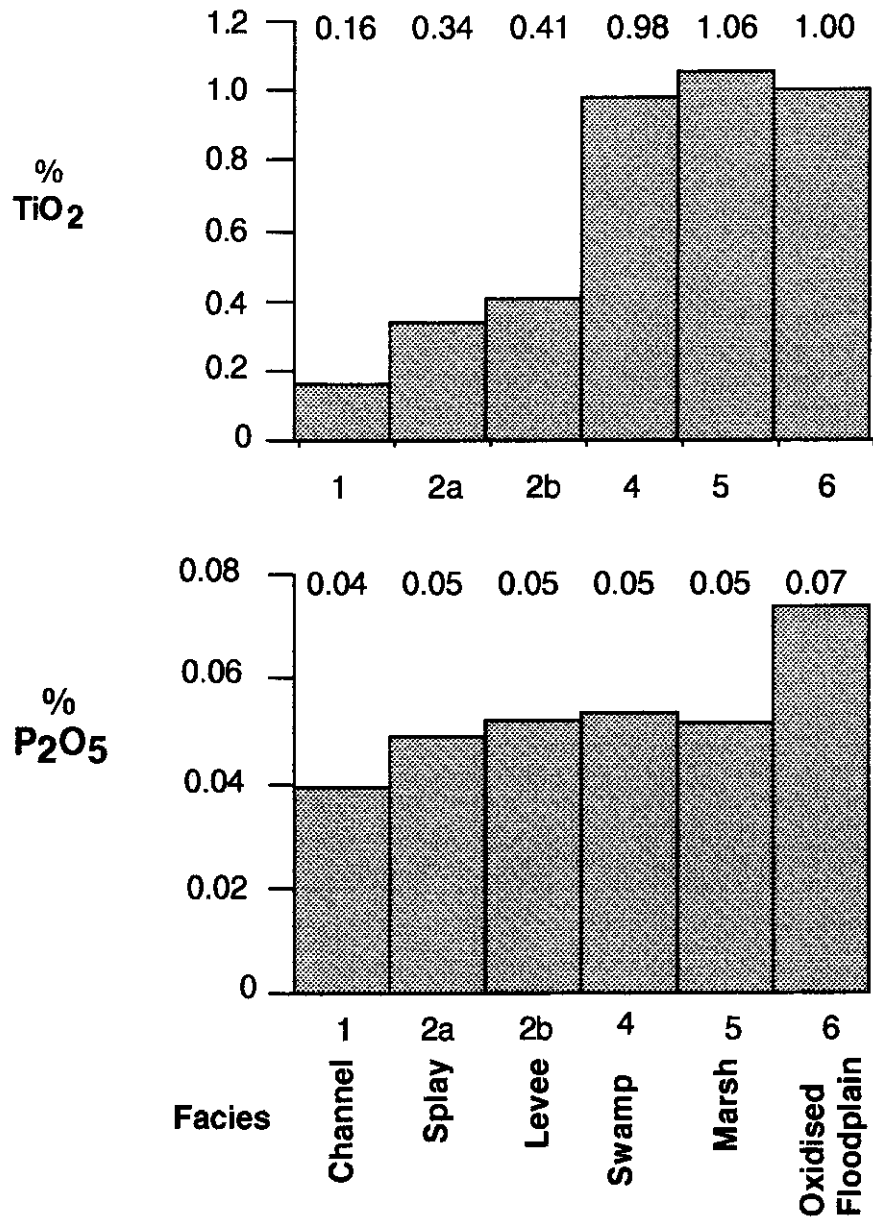


Figure 39. a) Facies versus TiO₂ content (%) b) Facies versus P₂O₅.

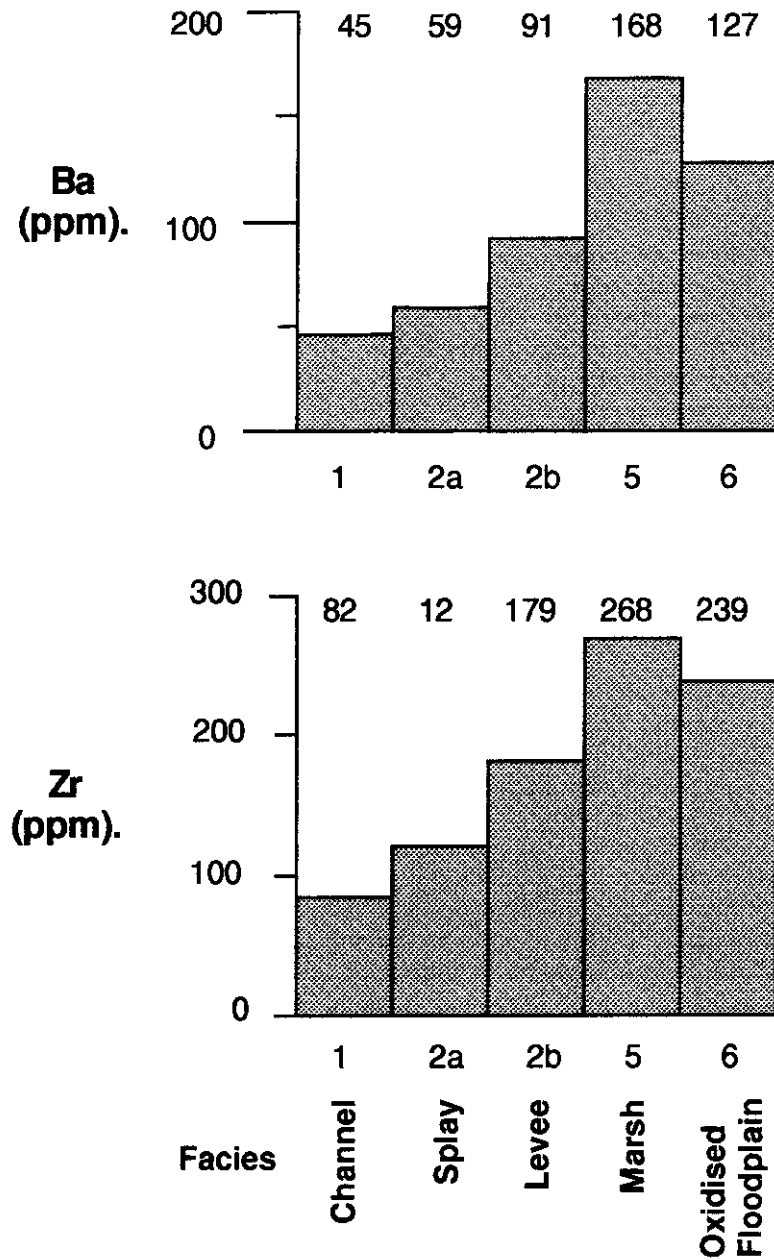


Figure 40. a) Facies versus Ba content (ppm) b) Facies versus Zr content (ppm).

Iron (expressed in Figure 38 lower as Fe_2O_3) is lowest in channel, splay and levee facies, and highest in marsh and oxidised floodplain deposits. In the channels it may occur as iron oxides cements, as pyrite cements, and as minor components of heavy minerals. In the floodplain facies iron is likely tied up in pyrite in swamp and marsh facies, and in iron oxides and sesquioxides in marsh and oxidised floodplain deposits.

Titanium (expressed in Figure 39 upper as TiO_2) is a minor component of the Mattagami Formation. It is present in trace amounts in channel and associated facies, and in greater abundance in floodplain facies. The dominance of TiO_2 in the floodplain facies indicates that it is unlikely to be tied up wholly in heavy minerals such as rutile, sphene, anatase and ilmenite. Phosphorous (expressed in Figure 39 lower as P_2O_5) is likewise present only in trace quantities. There seems to be no significant difference in concentration between channel and over-bank facies, with marginally higher values only in oxidised floodplain facies.

Barium and zirconium occur in trace quantities in all facies (see Table 2, Figure 40). Higher barium values in marsh and oxidised floodplain facies may indicate that it occurs preferentially as barite. Enhanced zirconium concentrations in marsh and oxidised floodplain facies suggest that it may not be entirely contained in detrital zircons, which might be expected in greater abundance in channel and levee facies.

Analysis of G.E.Brightness values for the less than 325 μm fraction of a limited number of samples (all from one hole) indicate slightly higher brightness values from channel and splay facies than floodplain facies indicating that the former may be more desirable a target for kaolin production for use in the manufacture of fine papers (Benbow 1989).

CONCLUSIONS

Strata of the Cretaceous Mattagami Formation in the Pike Creek area were deposited as part of a high-constructive (anastomosed) river system which drained a low relief shield area with a thin cover of Paleozoic strata, located to the south of the Moose River Basin. The exceptional abundance of channel deposits in this area is in marked contrast to many modern anastomosed systems where channels form only 5 to 20% of the floodplain. The high local concentration in the Pike Creek area may in part be related to nodal avulsion in the more proximal parts of an anastomosed system, as is seen for example in the proximal parts of the modern Saskatchewan River system east of Squaw Rapids (Smith 1983; Pabian-Goyhenche et al. 1990). Major reorganization of local flow patterns appears to have taken place between the time periods represented by paleogeographic maps T 0.4 and 0.6; T 2.2 and 2.6; and T 3.0 and 3.4 (see Figures 11 to 33).

A second factor which may have influenced channel density in the Pike Creek area may have been basement control on the position of rivers entering the Moose River Basin. This control is still apparent in that the location of modern rivers, such as the Abitibi and Mattagami; the positions of which appear to be strongly influenced by shear zones in the Precambrian basement.

The distribution and optical quality of kaolin in the Pike Creek Area appears to be strongly influenced by depositional facies. While kaolin is most abundant in floodplain facies, much of this is mixed with minor amounts of illite and other clays, and in addition is partly coloured by organics and/or iron oxides. While some of the lighter coloured (white) clays in these facies could be selectively separated for use in the paper industry, the tinted clays have a greater potential as "ball clays" (Russell 1989) in the ceramics industry, or could be treated to remove impurities and fine grained silica.

Kaolins formed by *in situ* breakdown of feldspars in the channel and levee

facies appear to have the highest (untreated) G.E.Brightness values and hence the greatest potential for use in the paper industry (Benbow 1989). Bristow (1989) indicates that an unfired brightness of at least ISO 75 (approximately 76.5 G.E. Brightness) after benification is needed in the paper industry. The average for the untreated, less than 325 μm , fraction in the channel facies in the Pike Creek area is slightly lower than this, but is likely to be higher in the less than 2 μm fraction after removal of coarser material. Bleaching may also increase the brightness values in the final product. Because the channel facies is easily recognisable in the field, and contains only minor silt-grade detrital quartz, the kaolin in this facies should be relatively easy to mine and separated from the quartz sand.

The Pike Creek area contains significant, recoverable quantities of Kaolin. It is capped by a thin cover of calcareous clay till (Figure 41), which could be used as a cover for acid generating tailings if transportation costs are sufficiently low. Both channel and overbank facies are potentially usable as sources of clay for the ceramic and paper industries. While the geometry of the deposit is complex it can be reconstructed from closely spaced bore-holes. Lateral correlations of the type shown in Figures 5 to 10 are essential in reconstructing the geometry of individual lithotypes. Paleogeographic reconstructions of the type shown in Figures 11 to 33 can be used directly in mine planning due to the strong relation between facies and kaolin content.

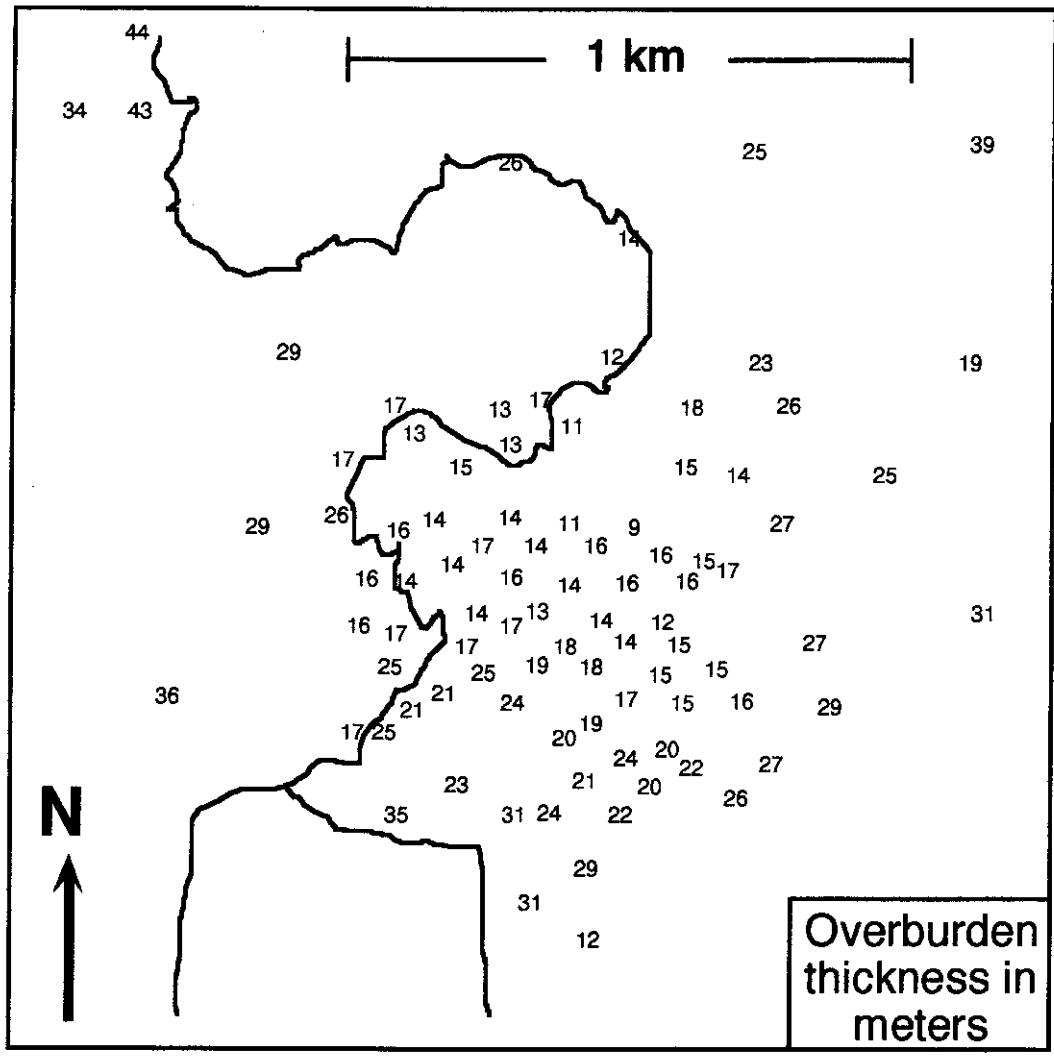


Figure 41. Overburden thickness in the Pike Creek area (in metres).

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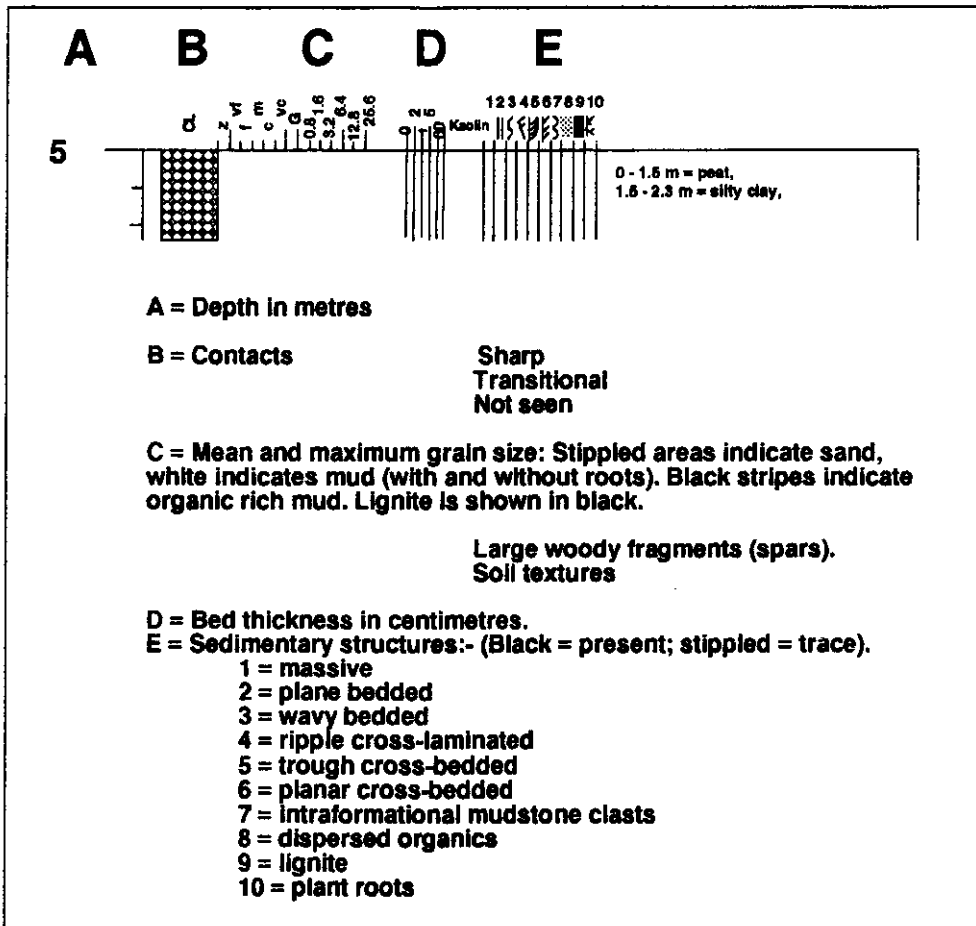
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APPENDIX 1

Graphic logs of holes from the Pike Creek area. Holes 89-27, 30, 40, 43, 46, 47, 52, 65, 69, 71, 74, 77, 82, 220 and 92-9, 10, 13, 14, 15, based on new observations.

Legend:-



ab = abundant; tr = trace; H.M. = heavy minerals; Dk = dark;

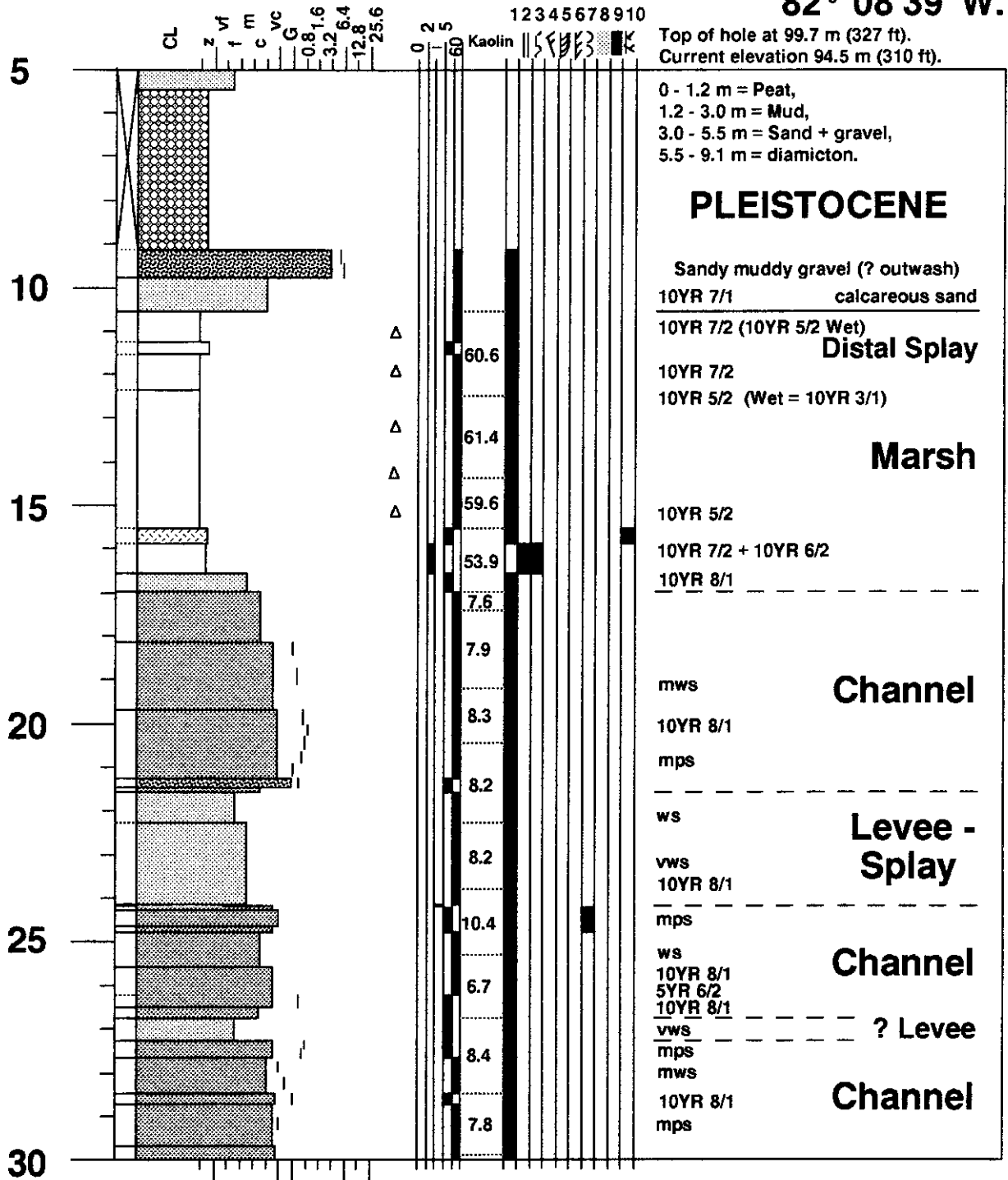
Md = medium; Lt = light.

B = brown; Y = yellow; W = white; Gy = grey; Blk = black; R = red;

Gn = green.

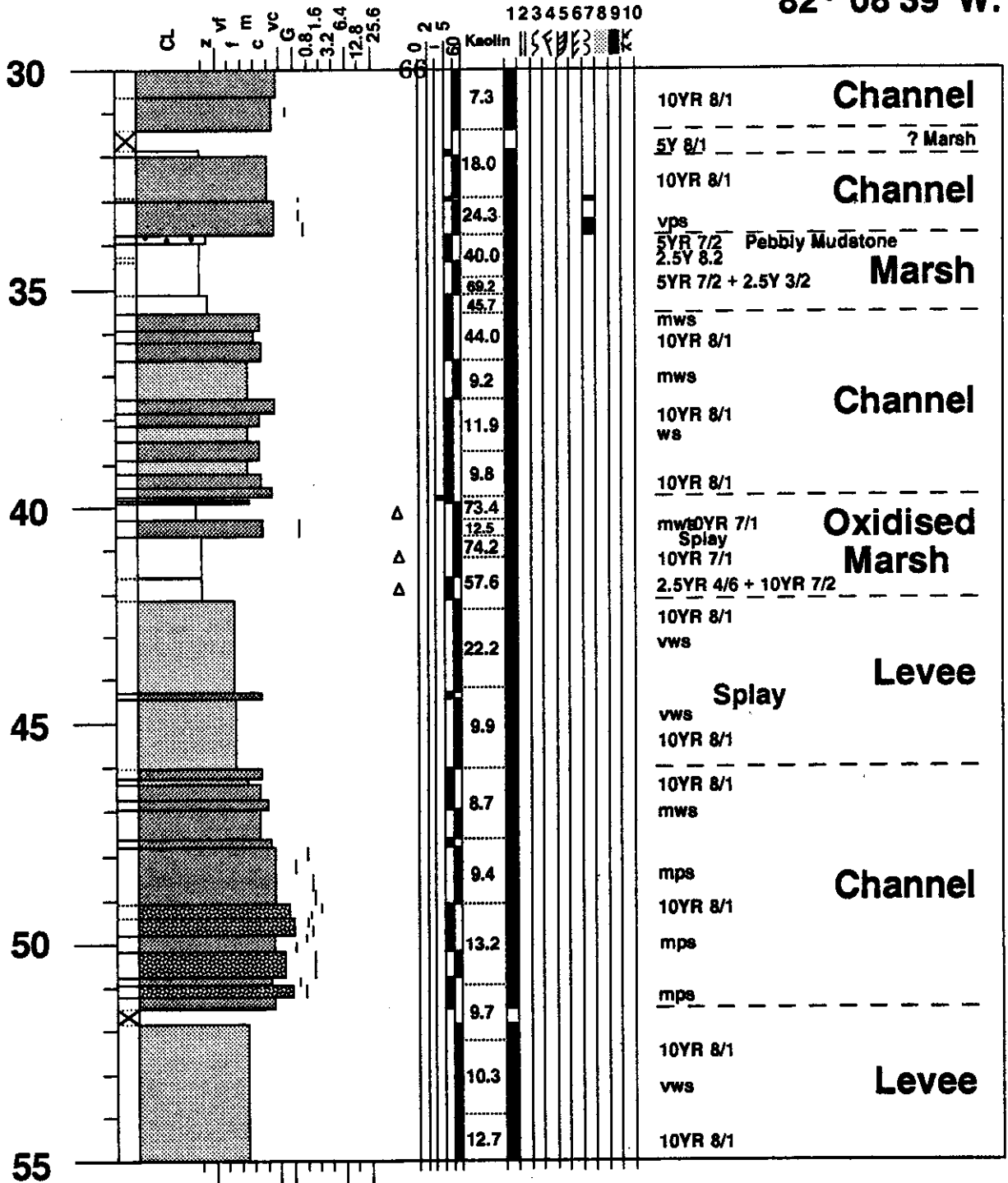
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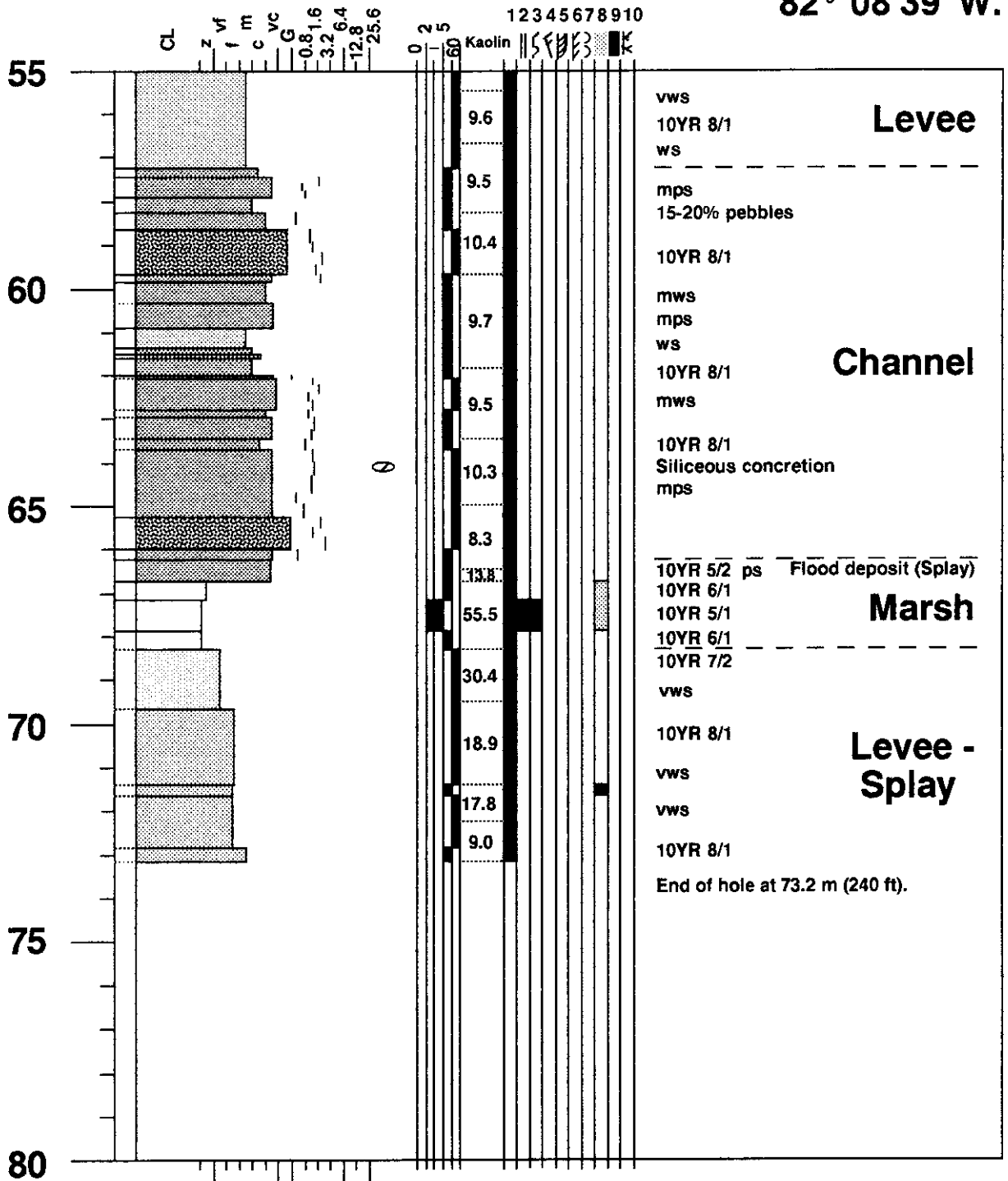
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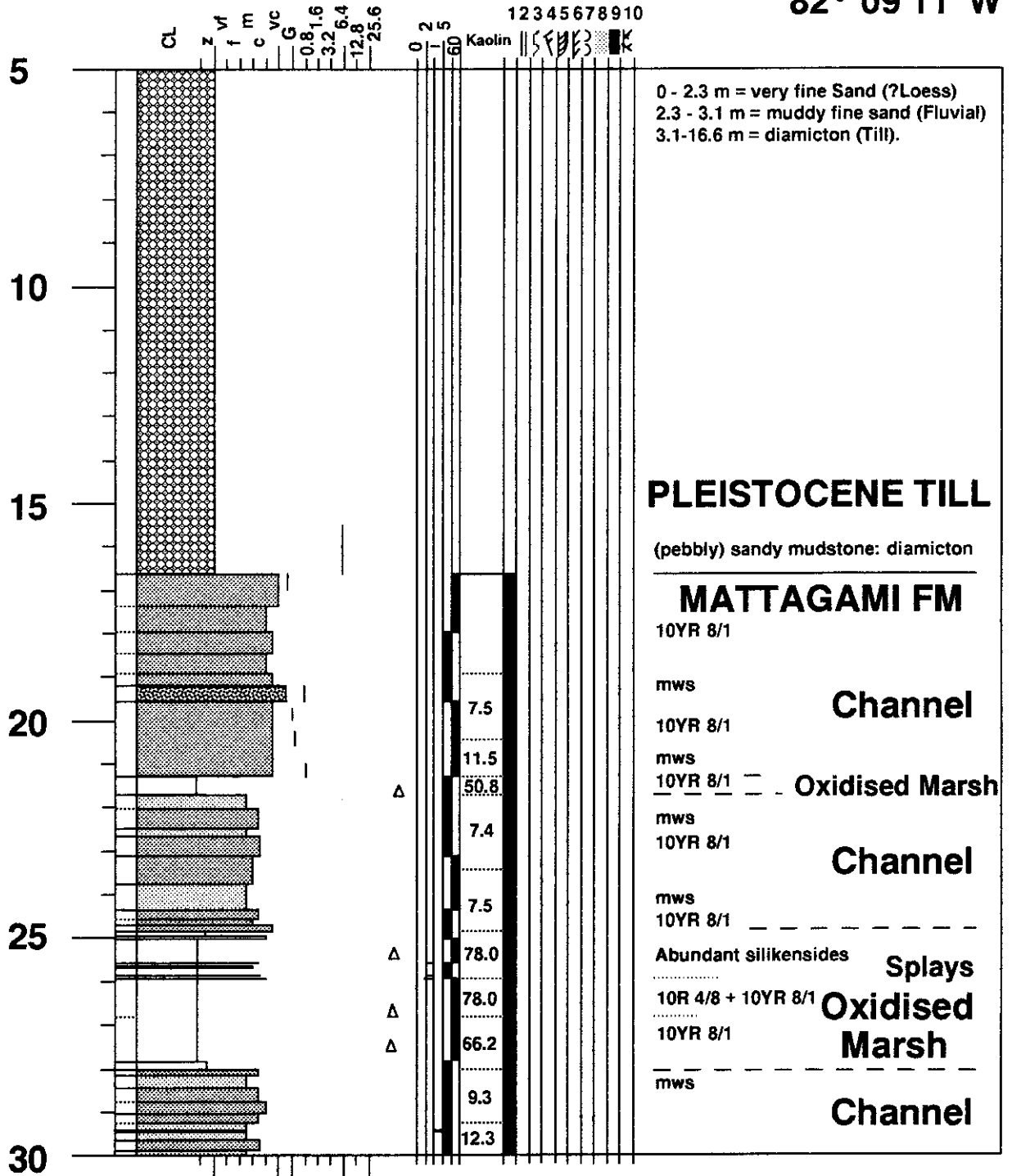
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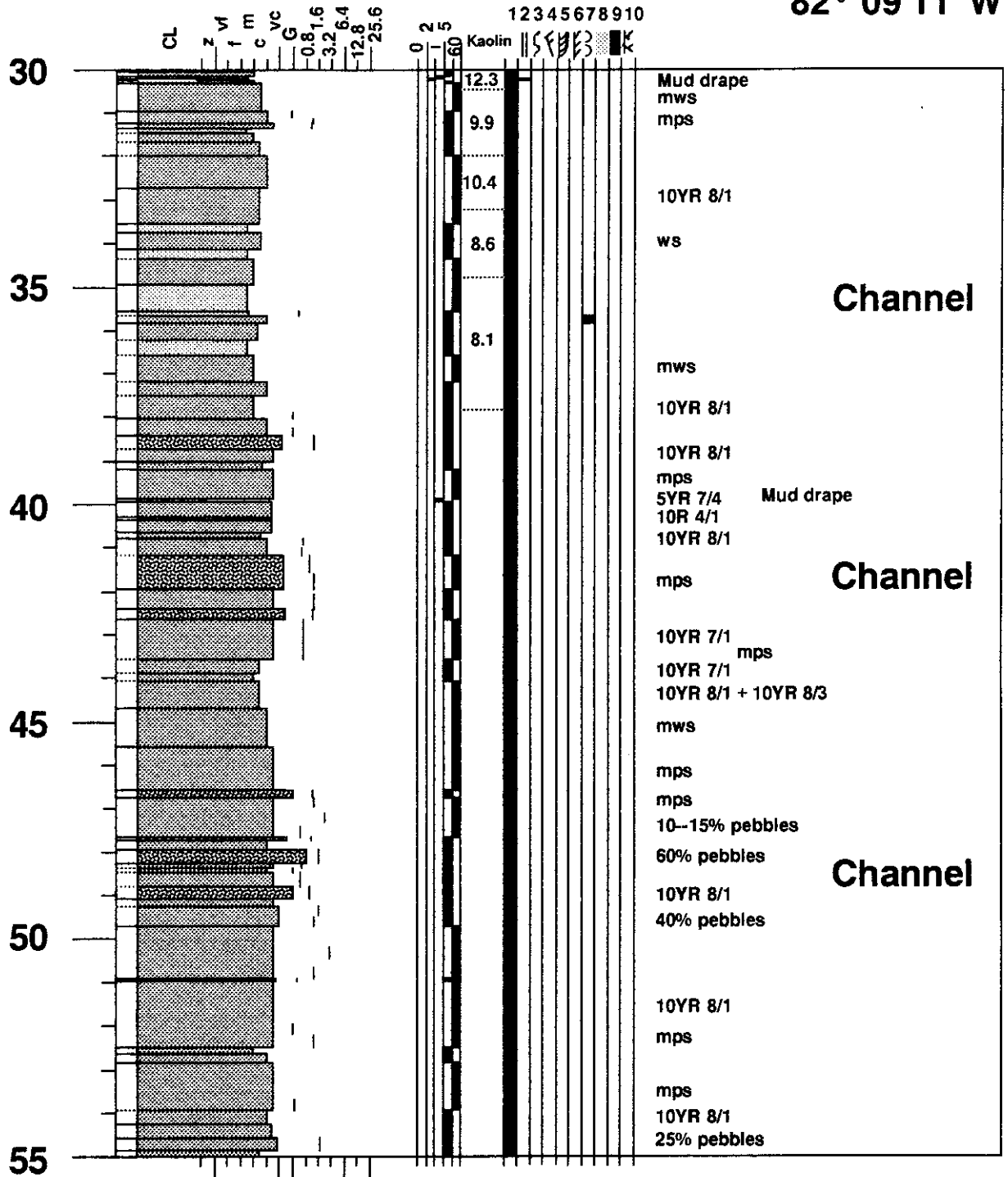
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50° 08'56"N,
82° 09'11"W



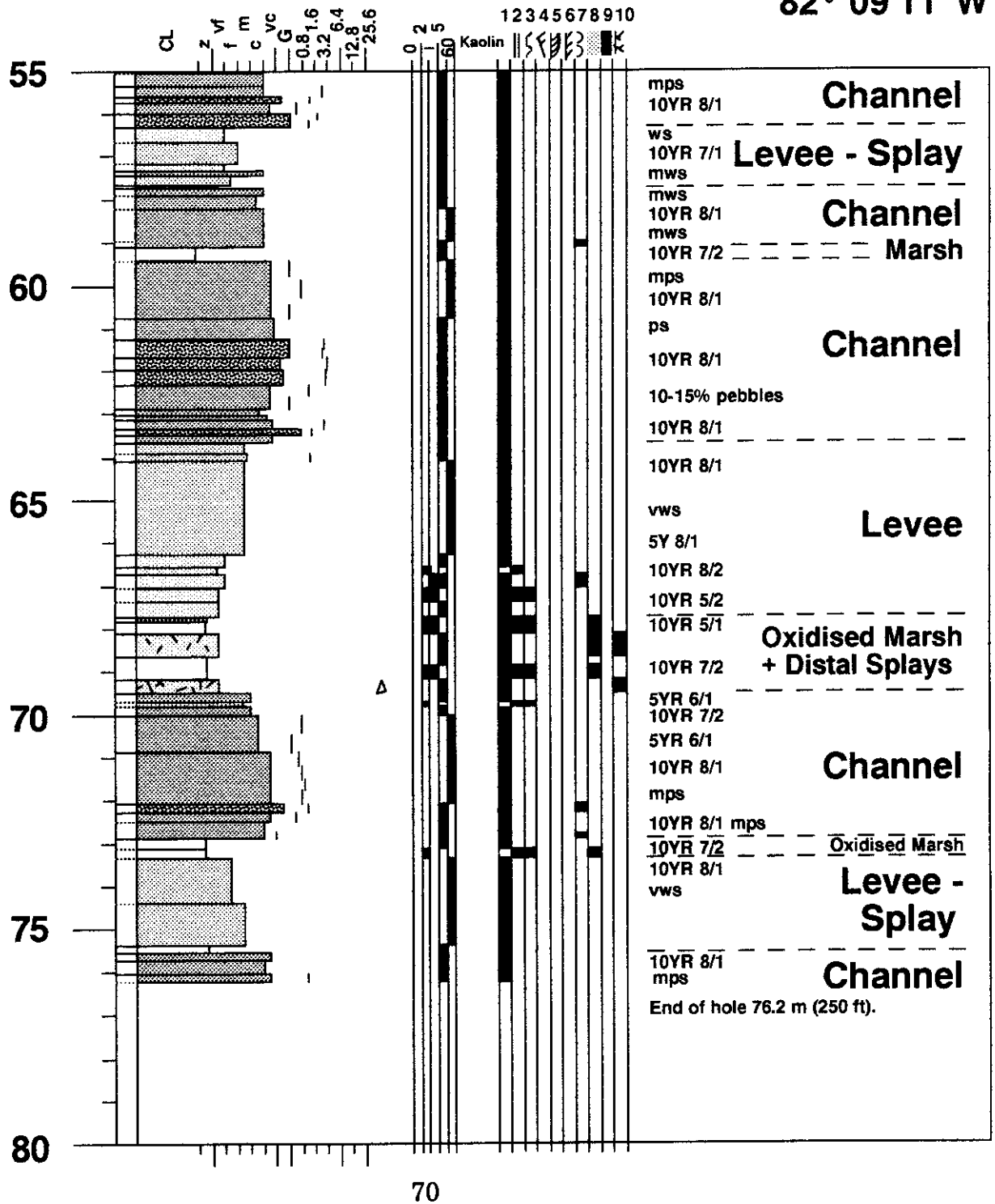
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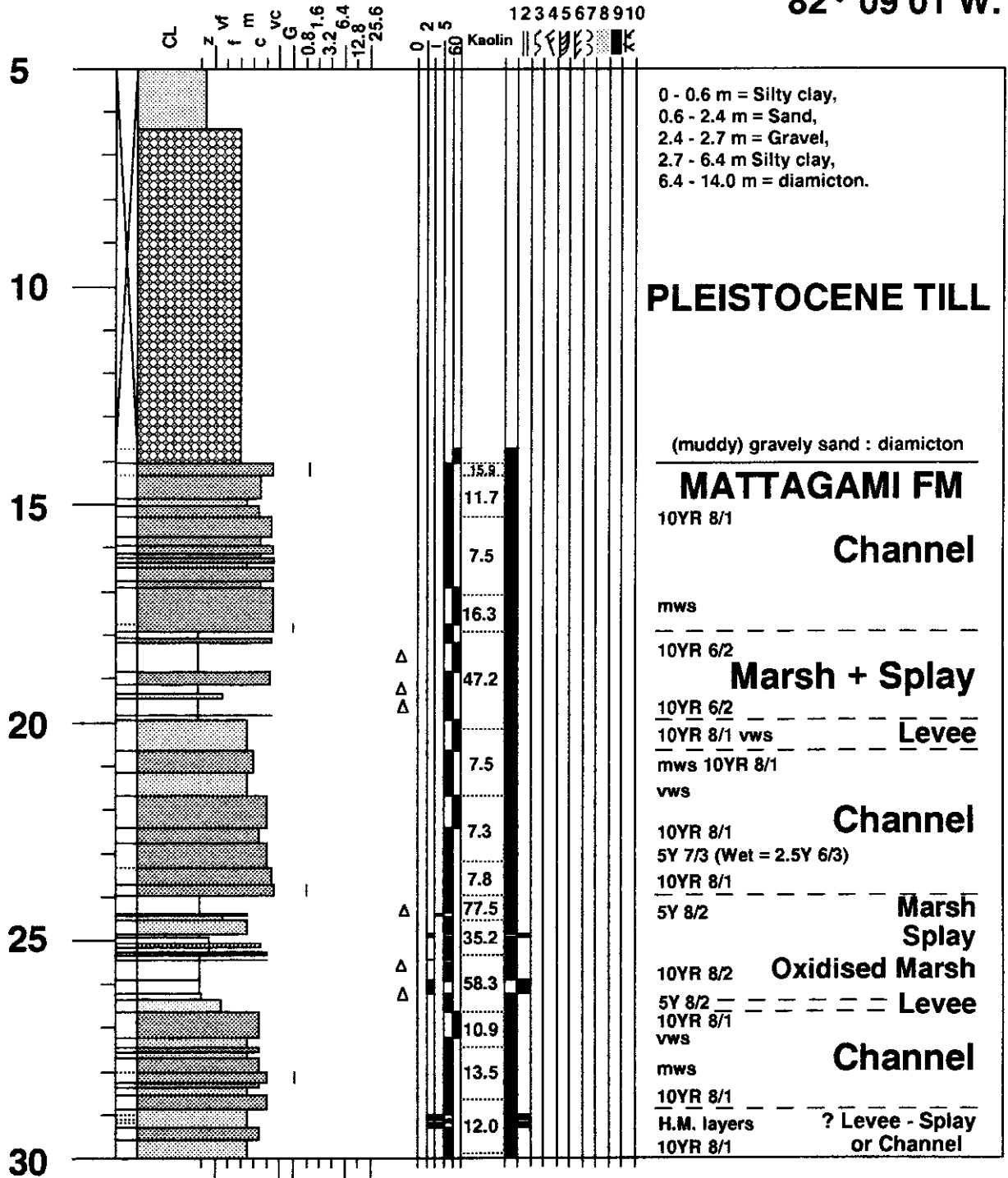
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82° 09'11"W



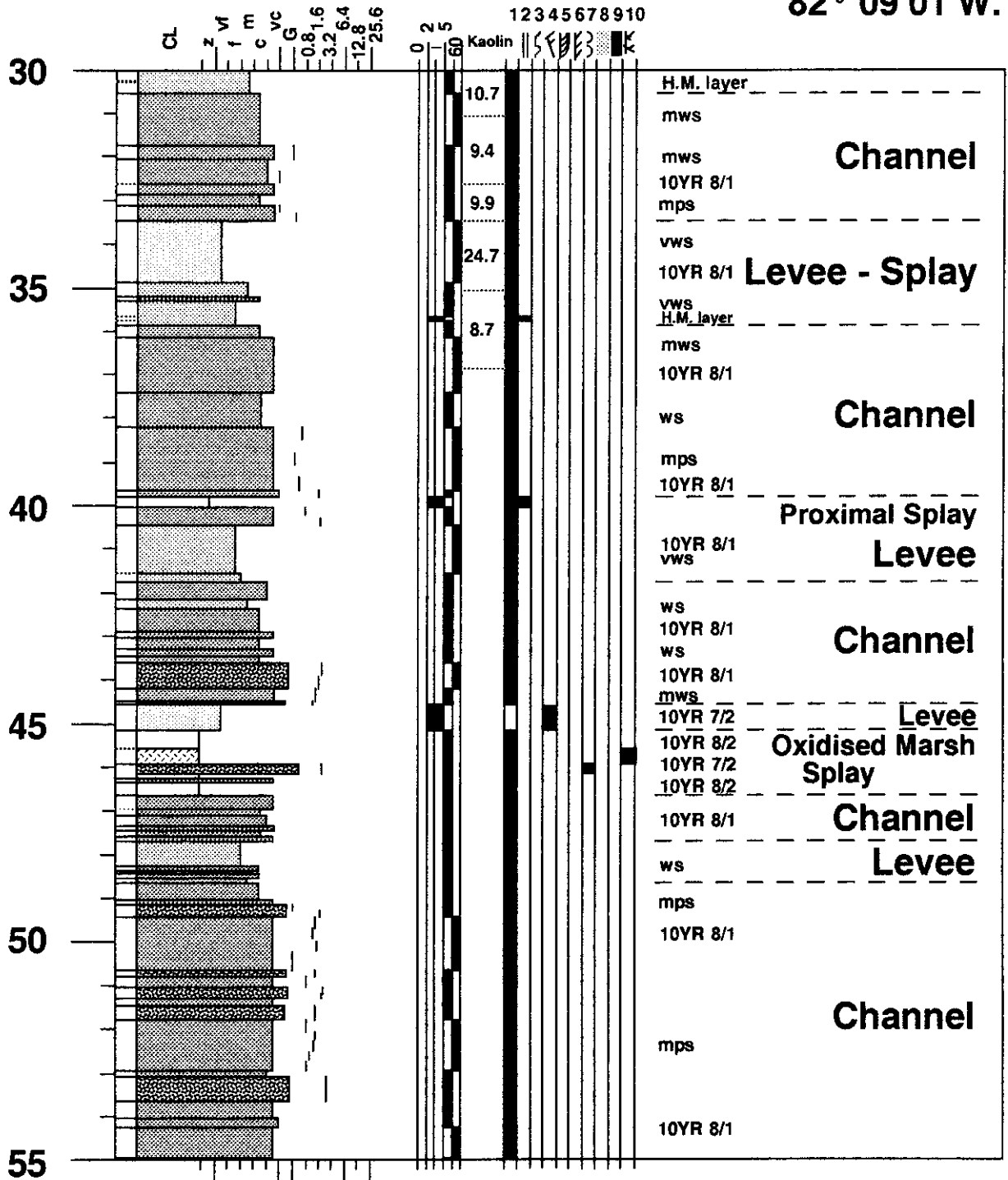
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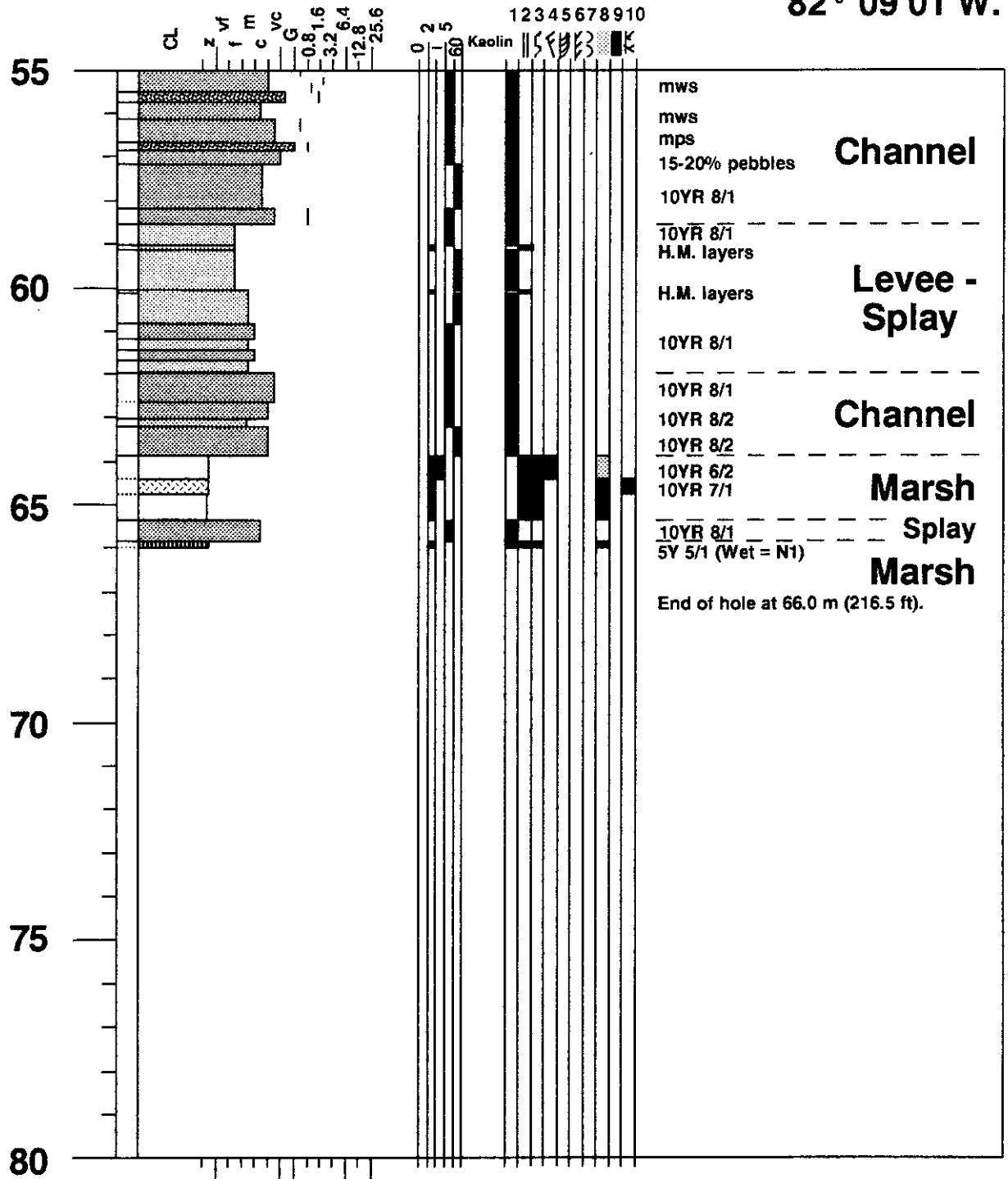
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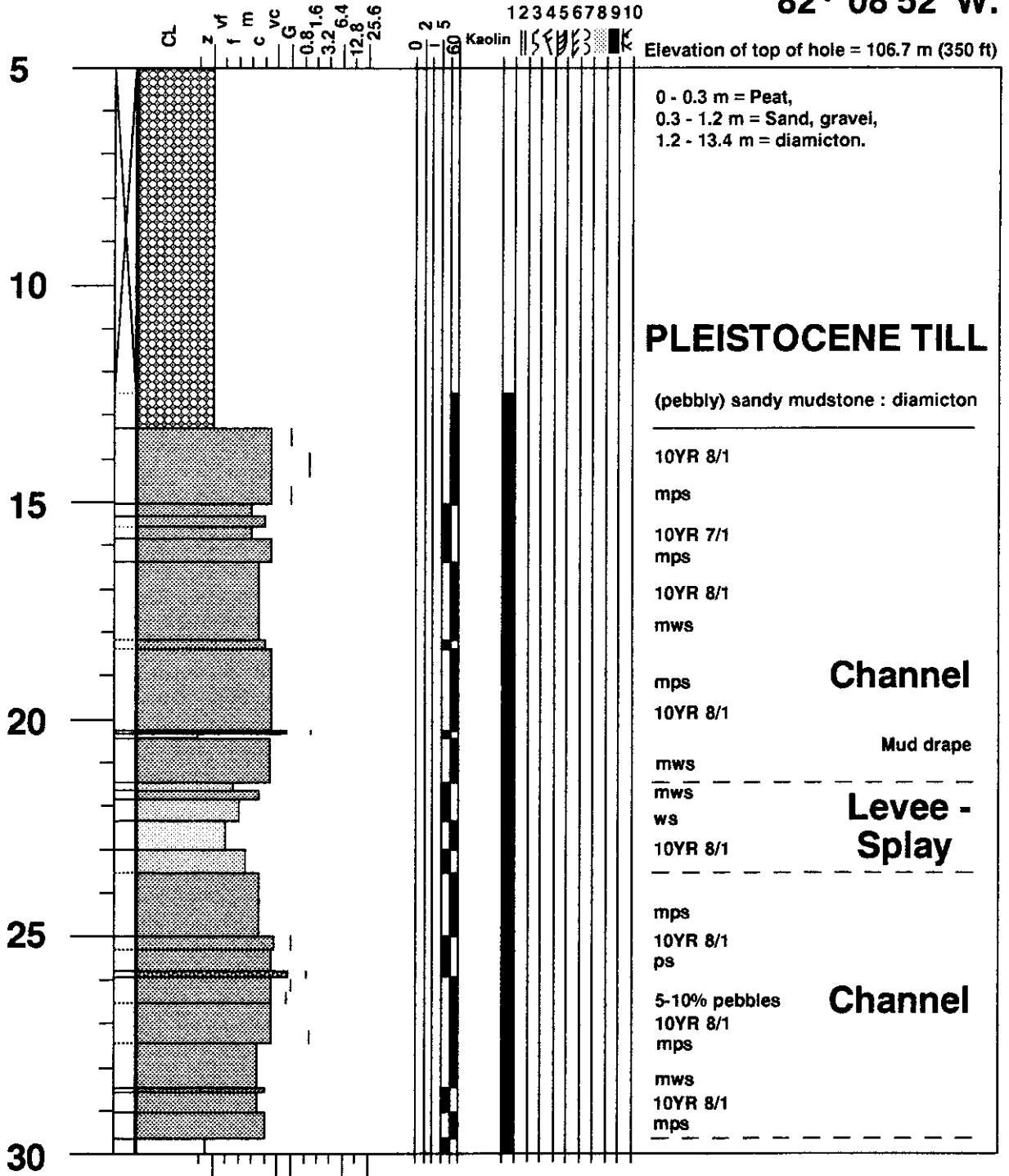
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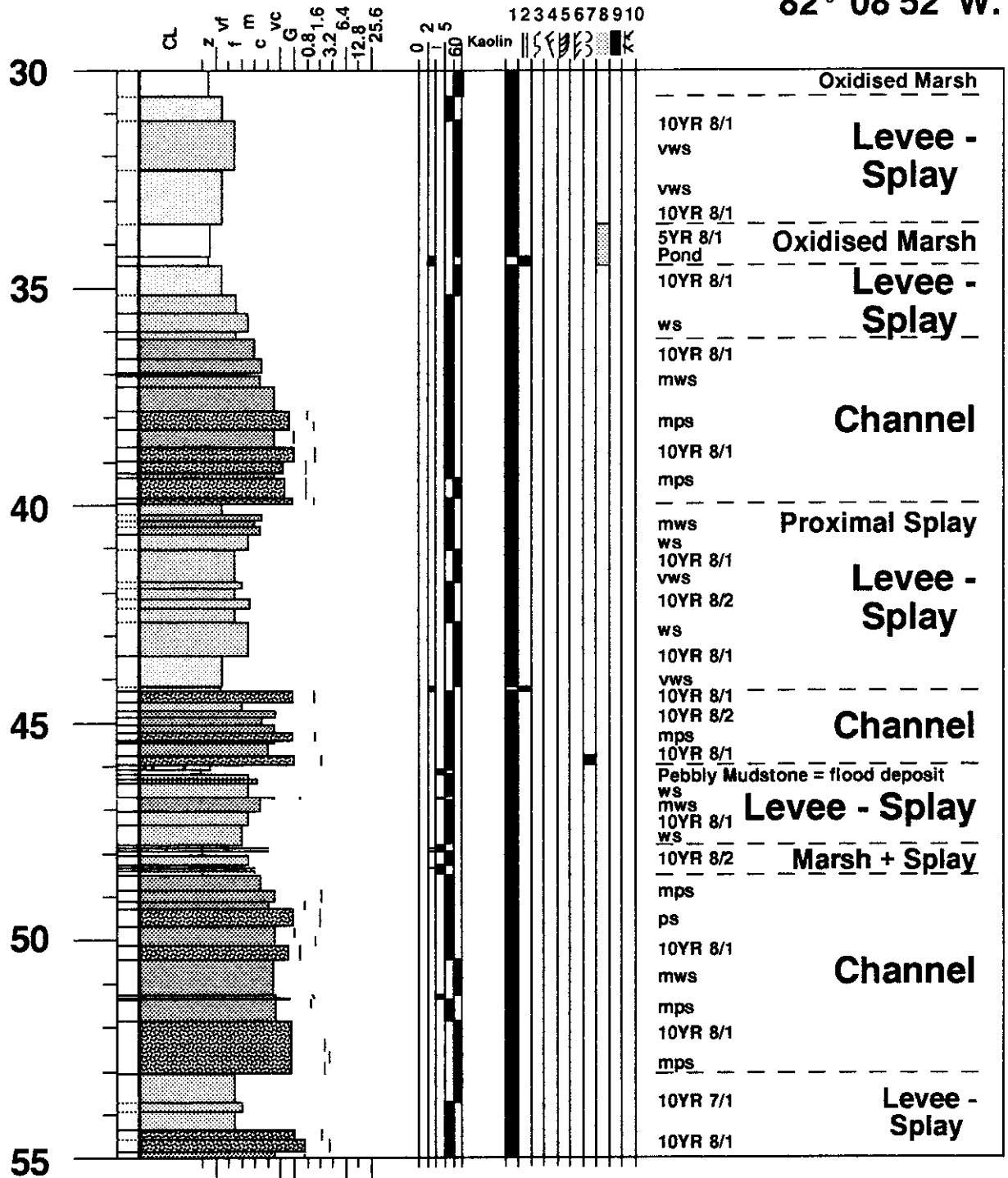
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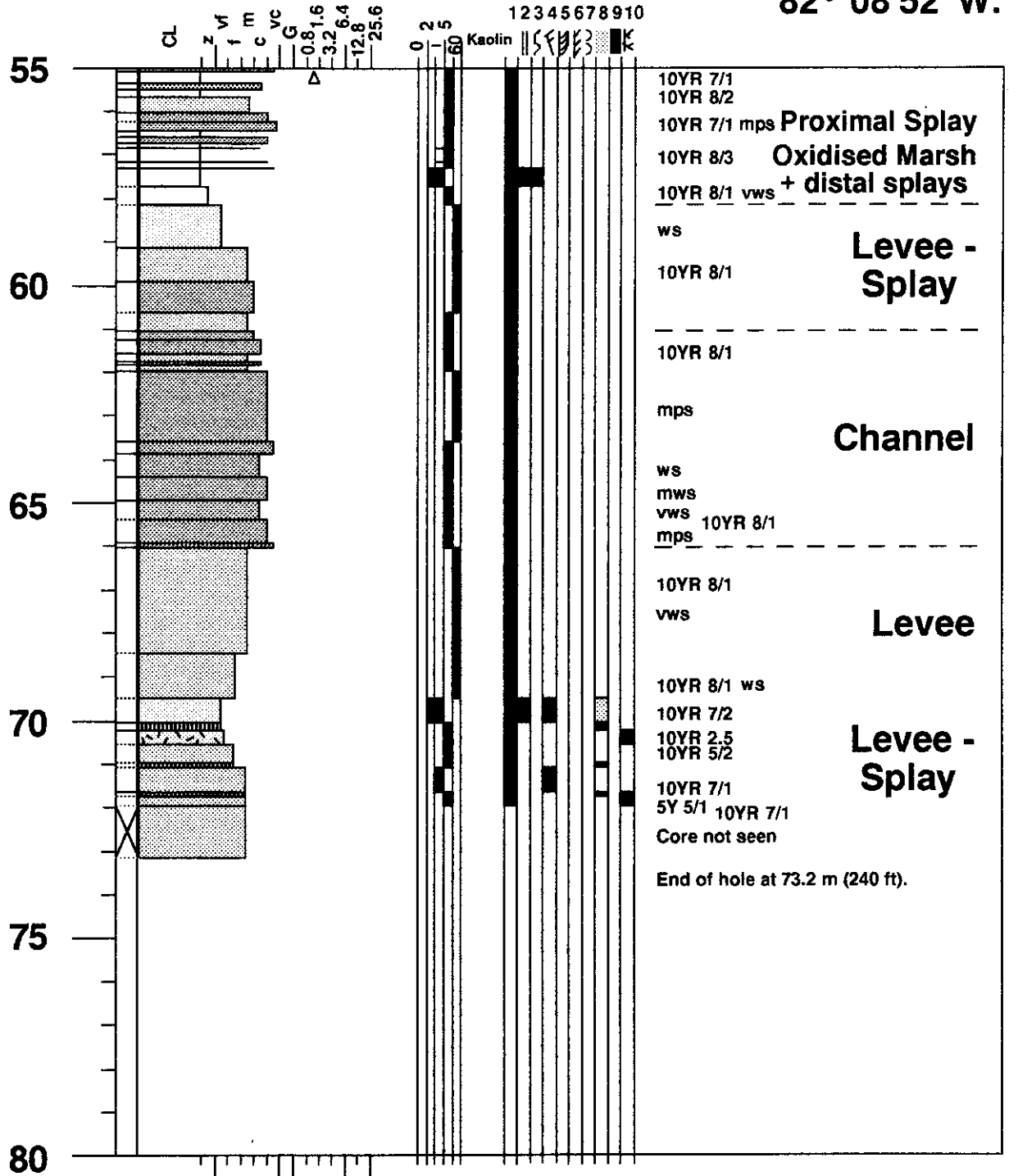
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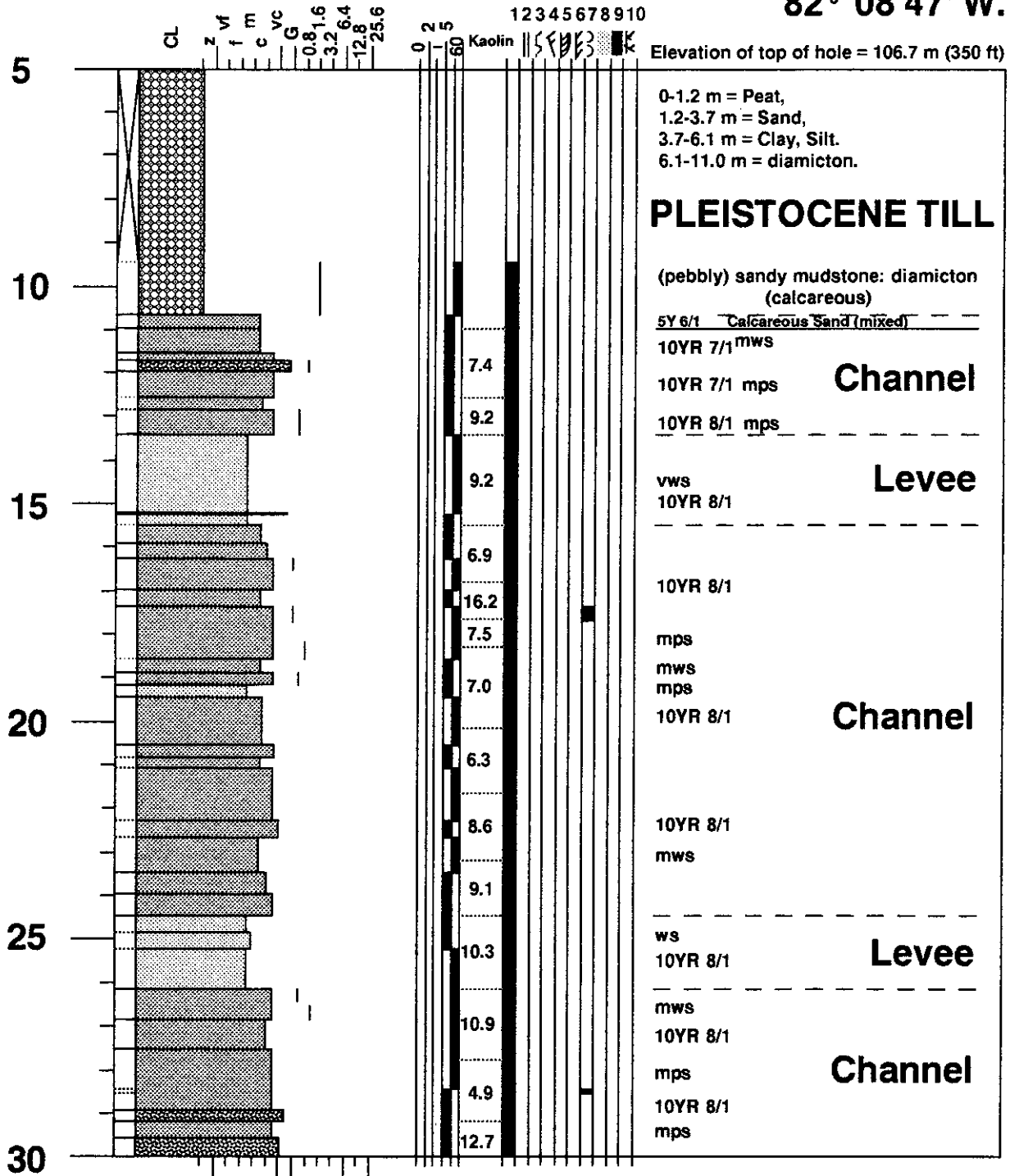
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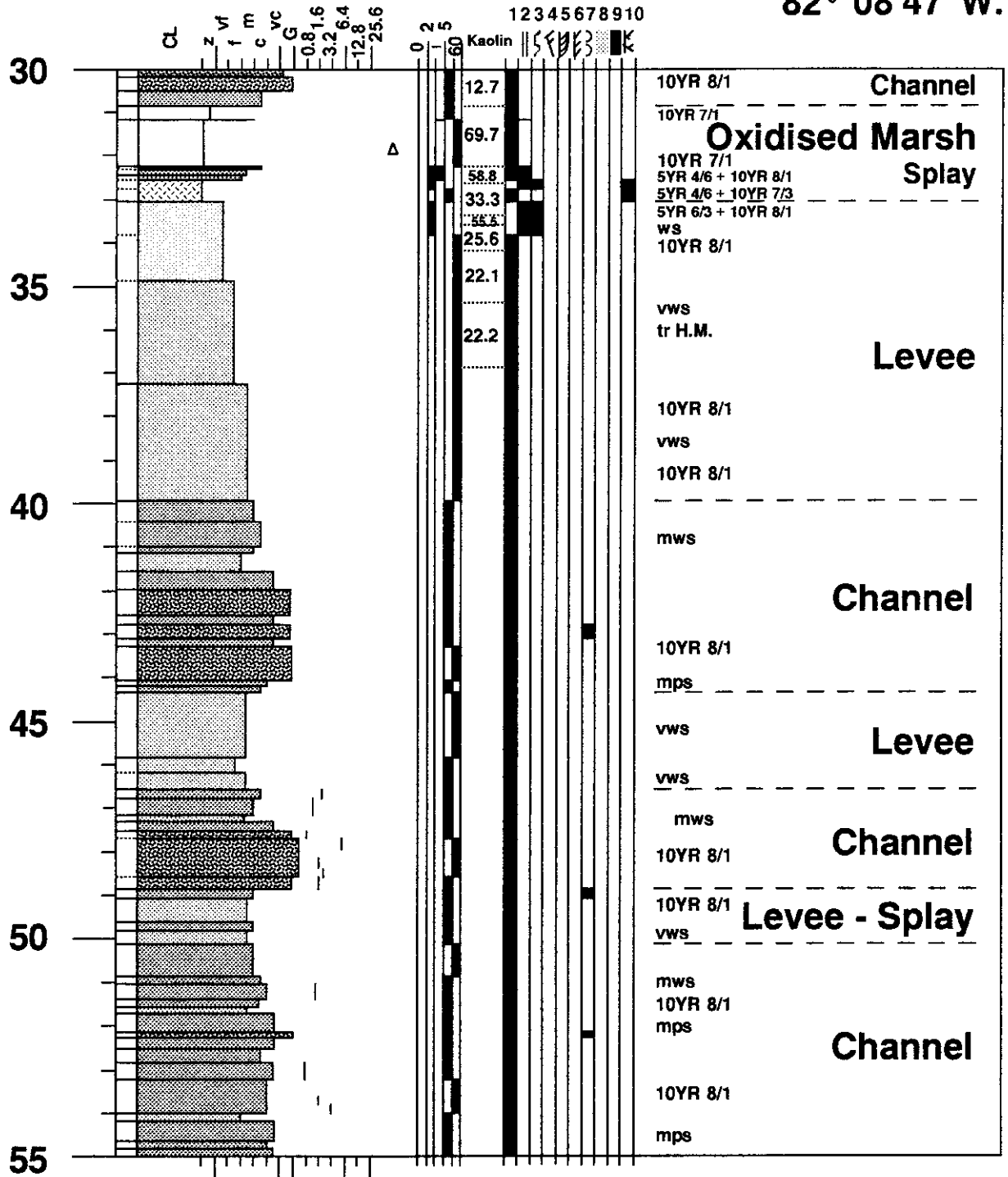
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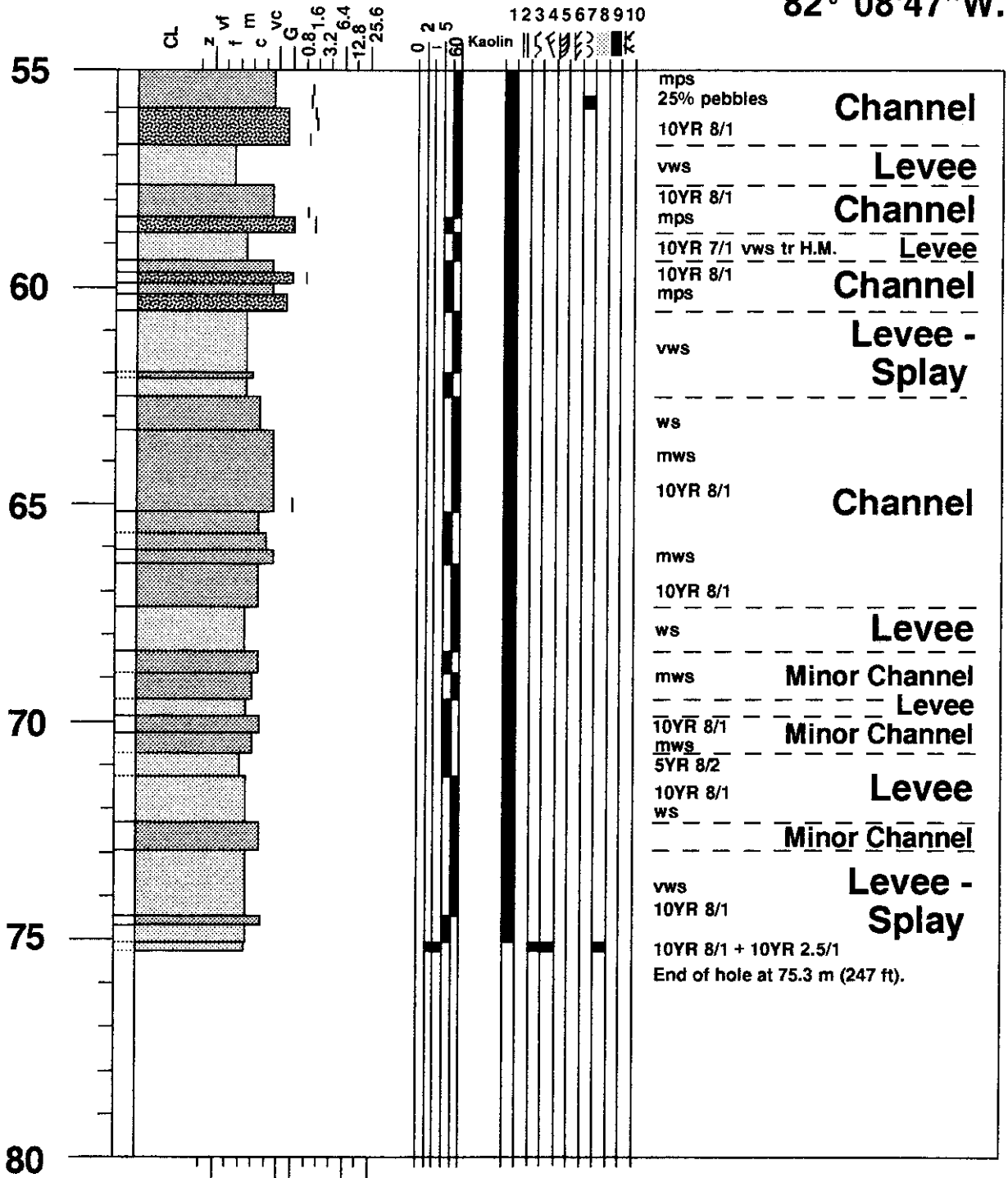
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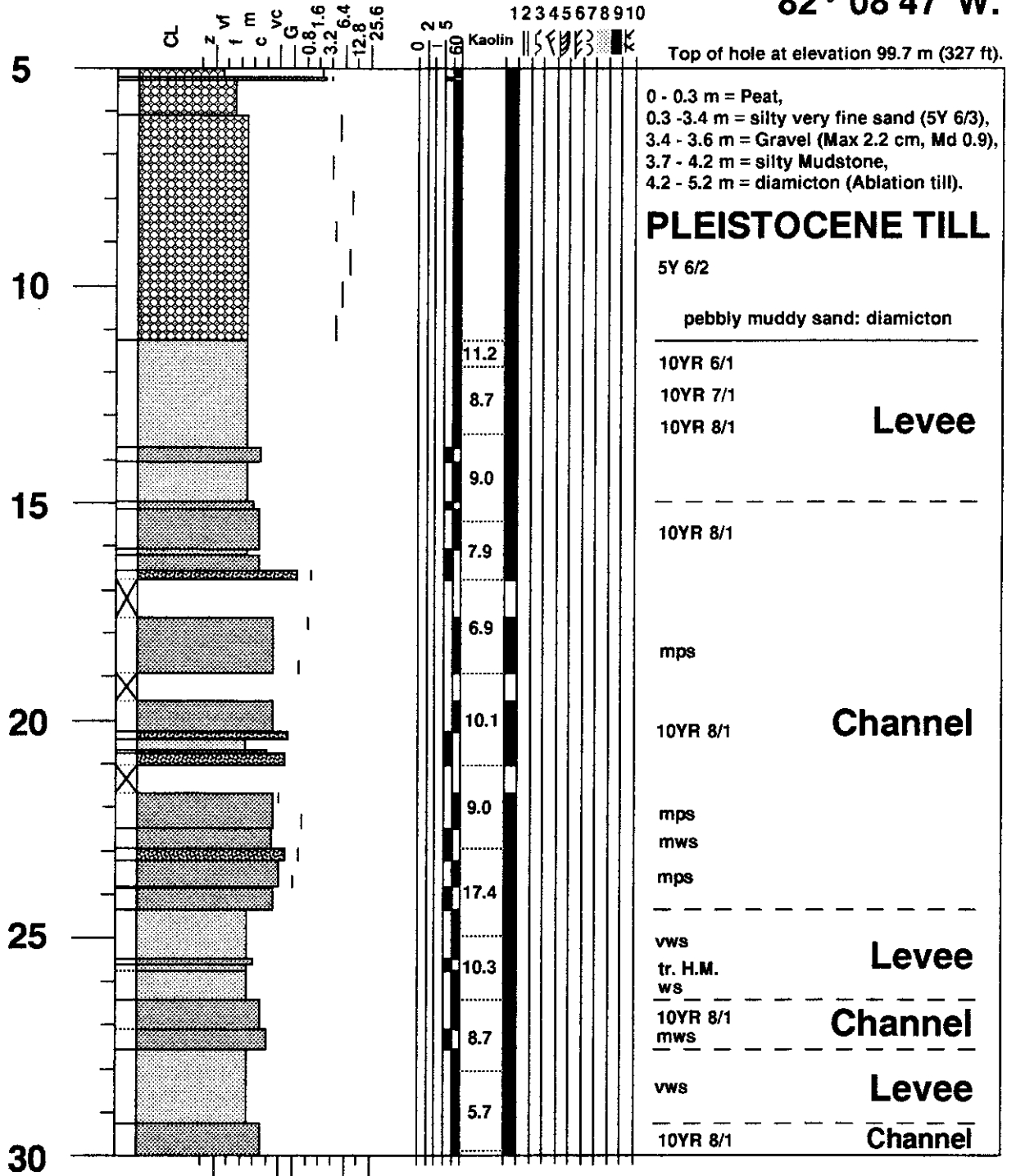
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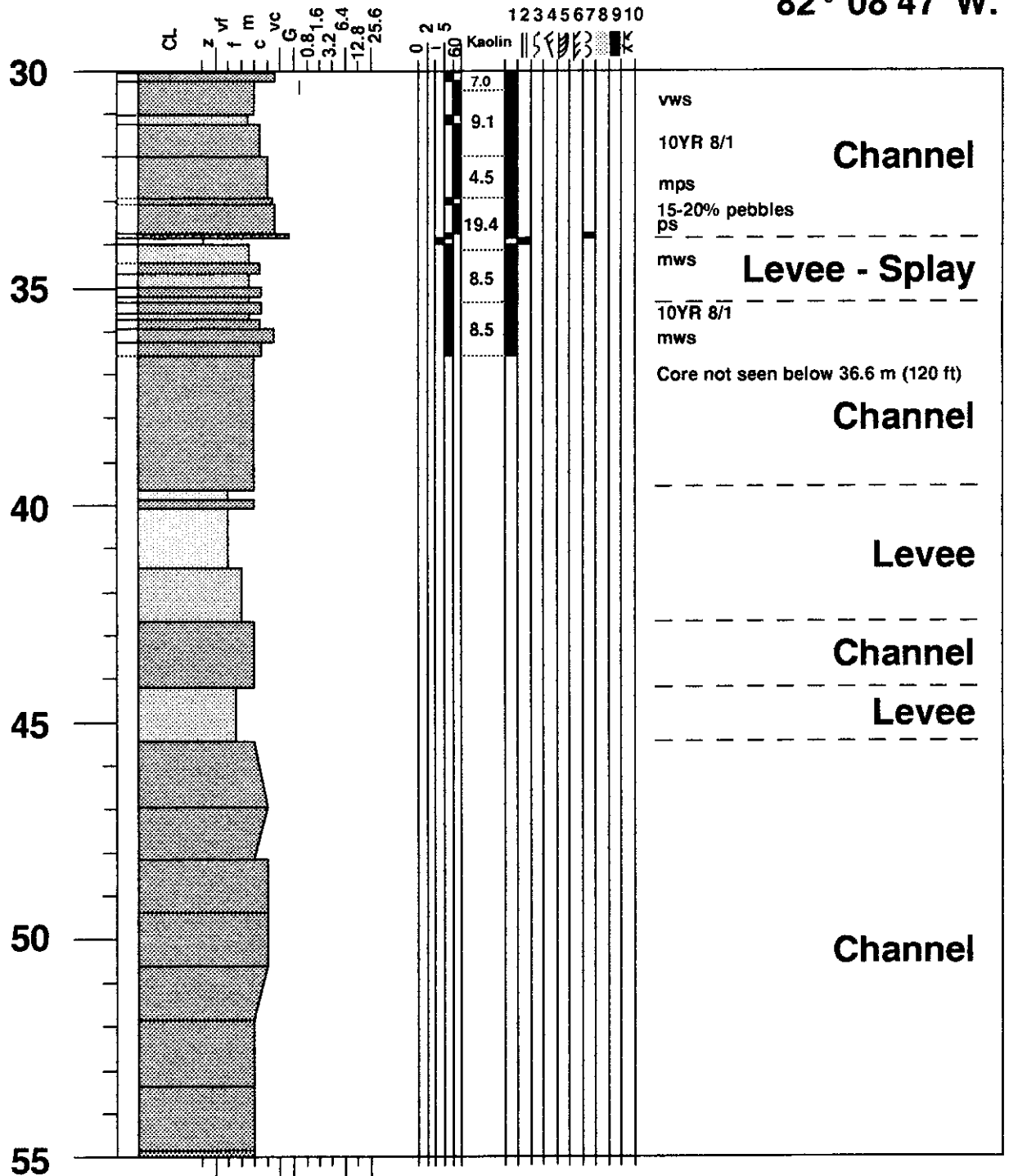
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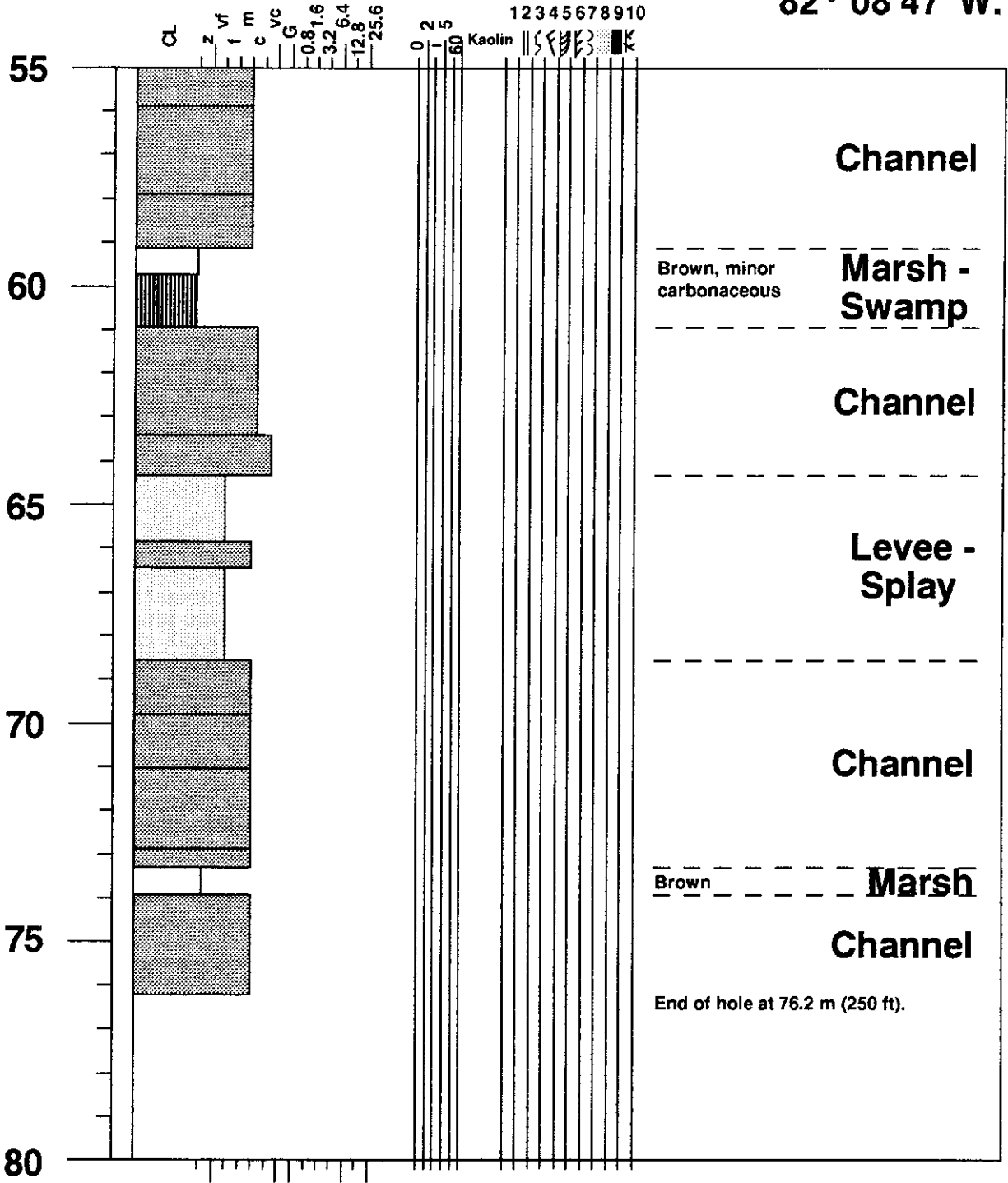
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**50° 08'53"N,
82° 08'47"W.**



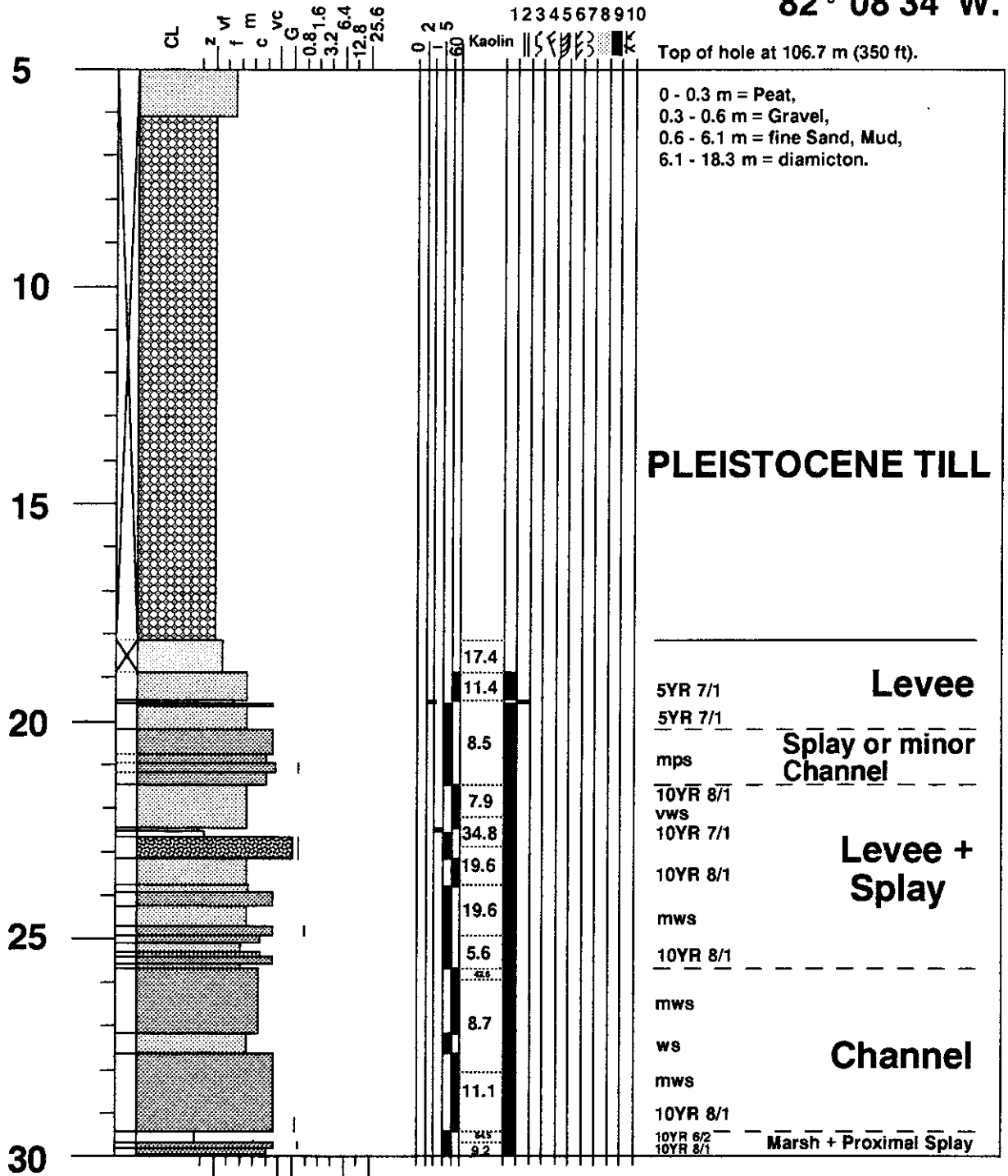
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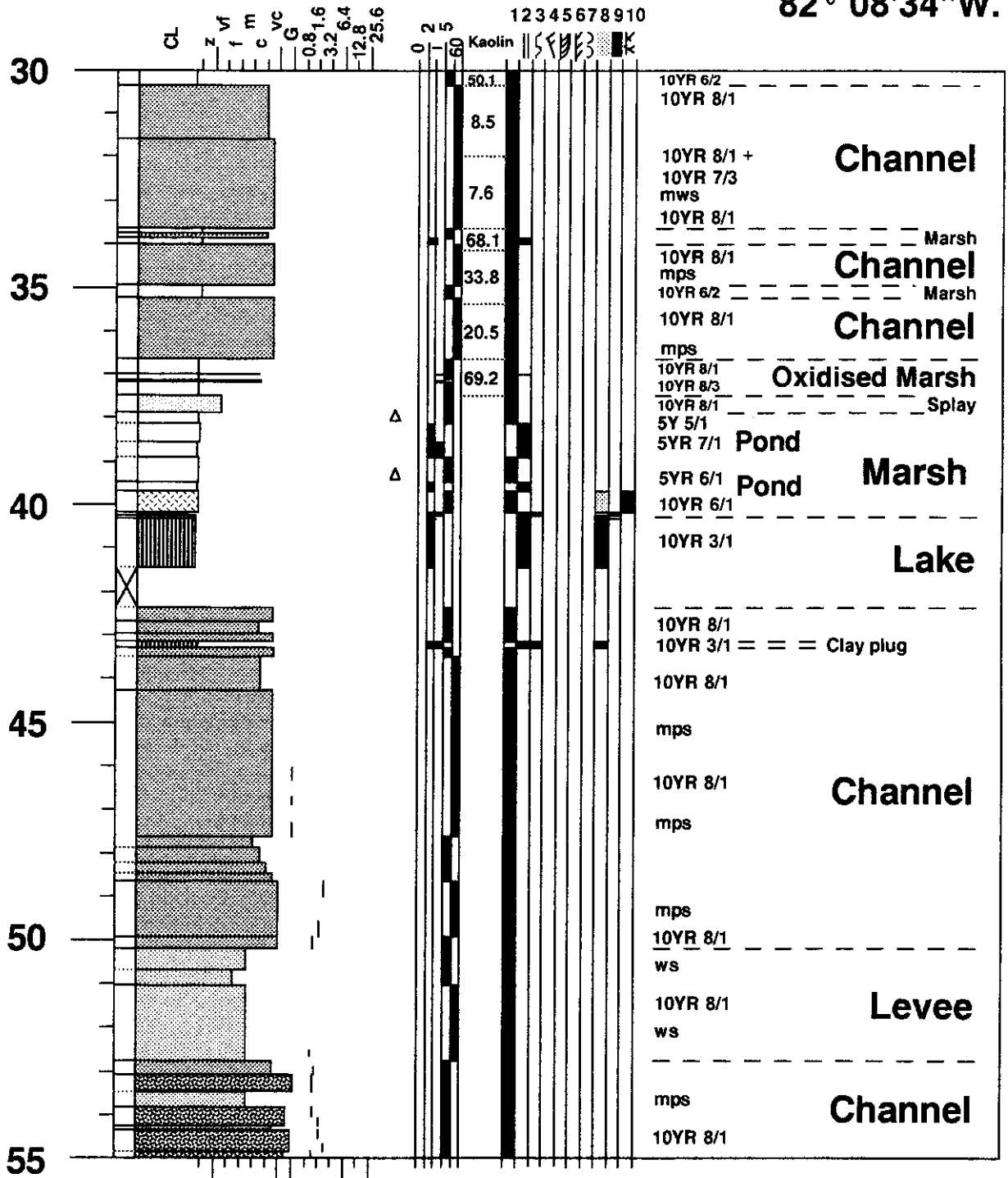
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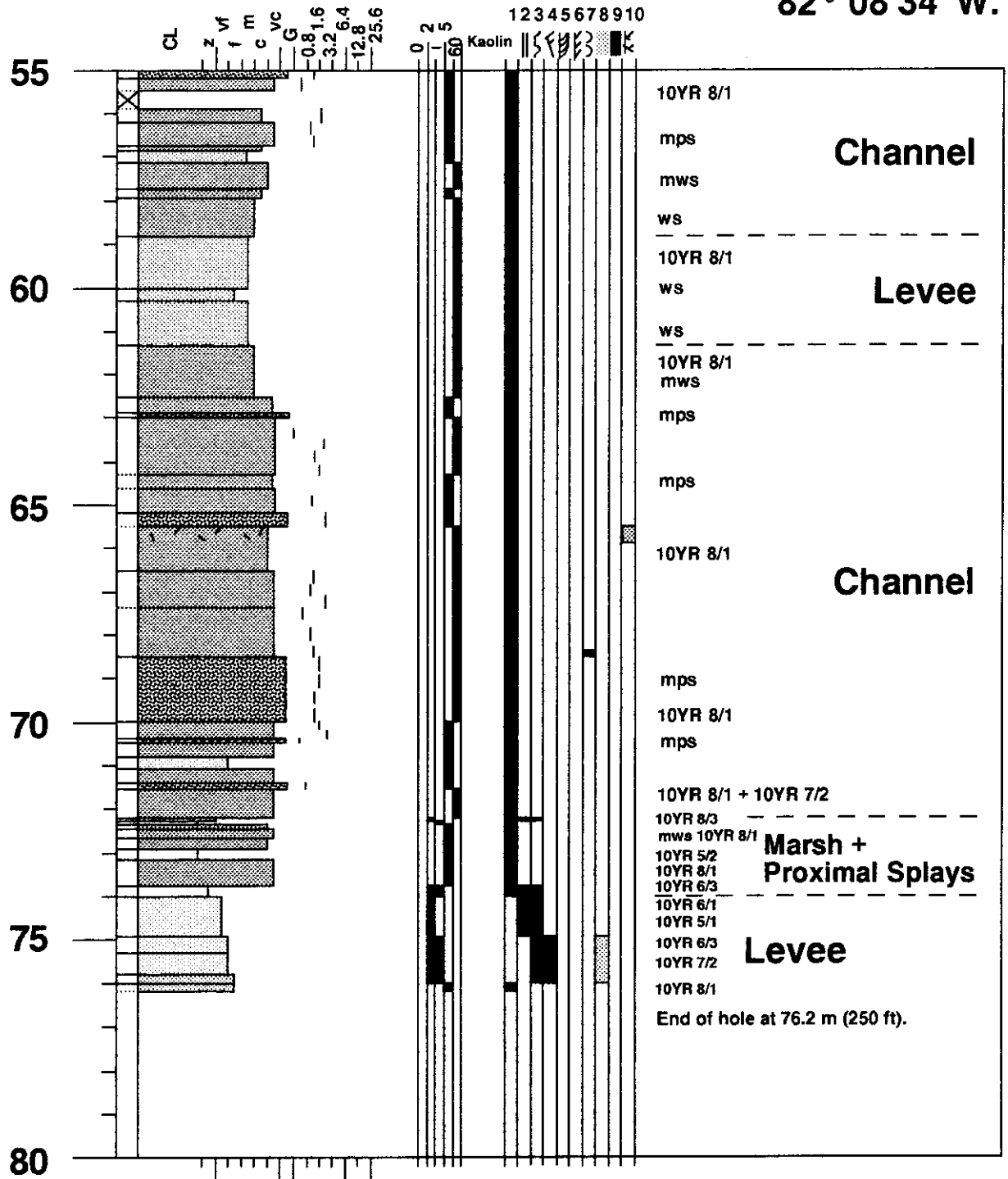
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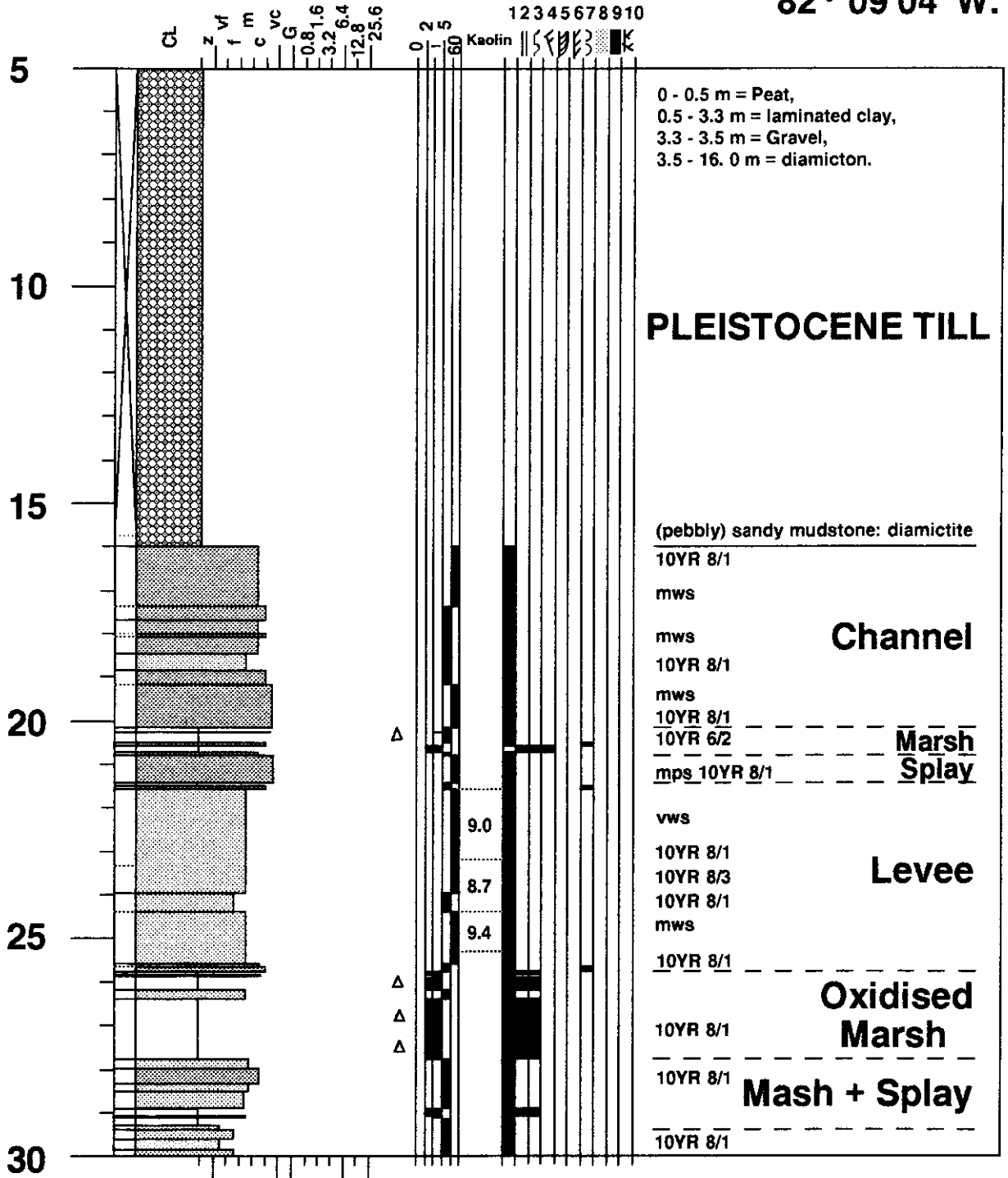
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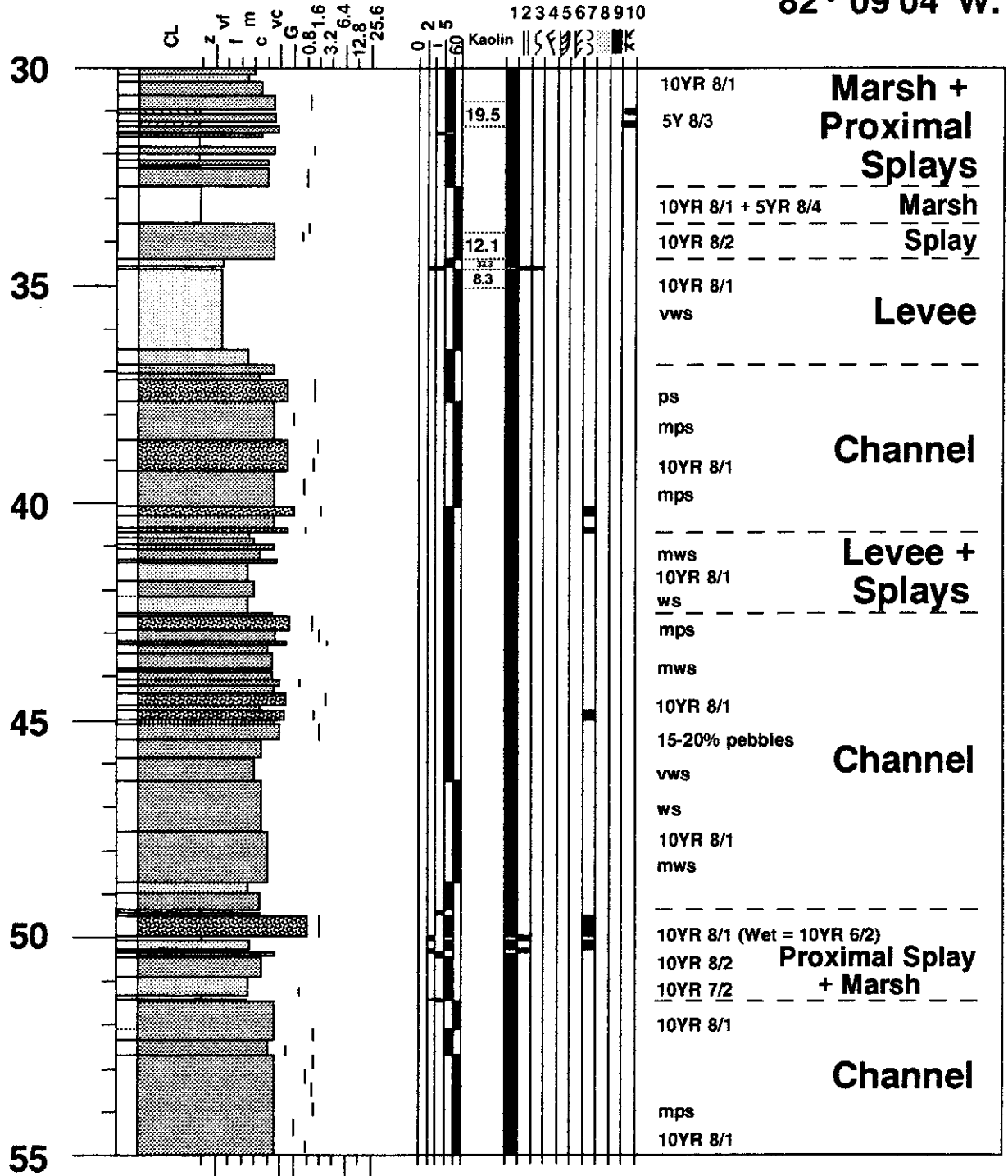
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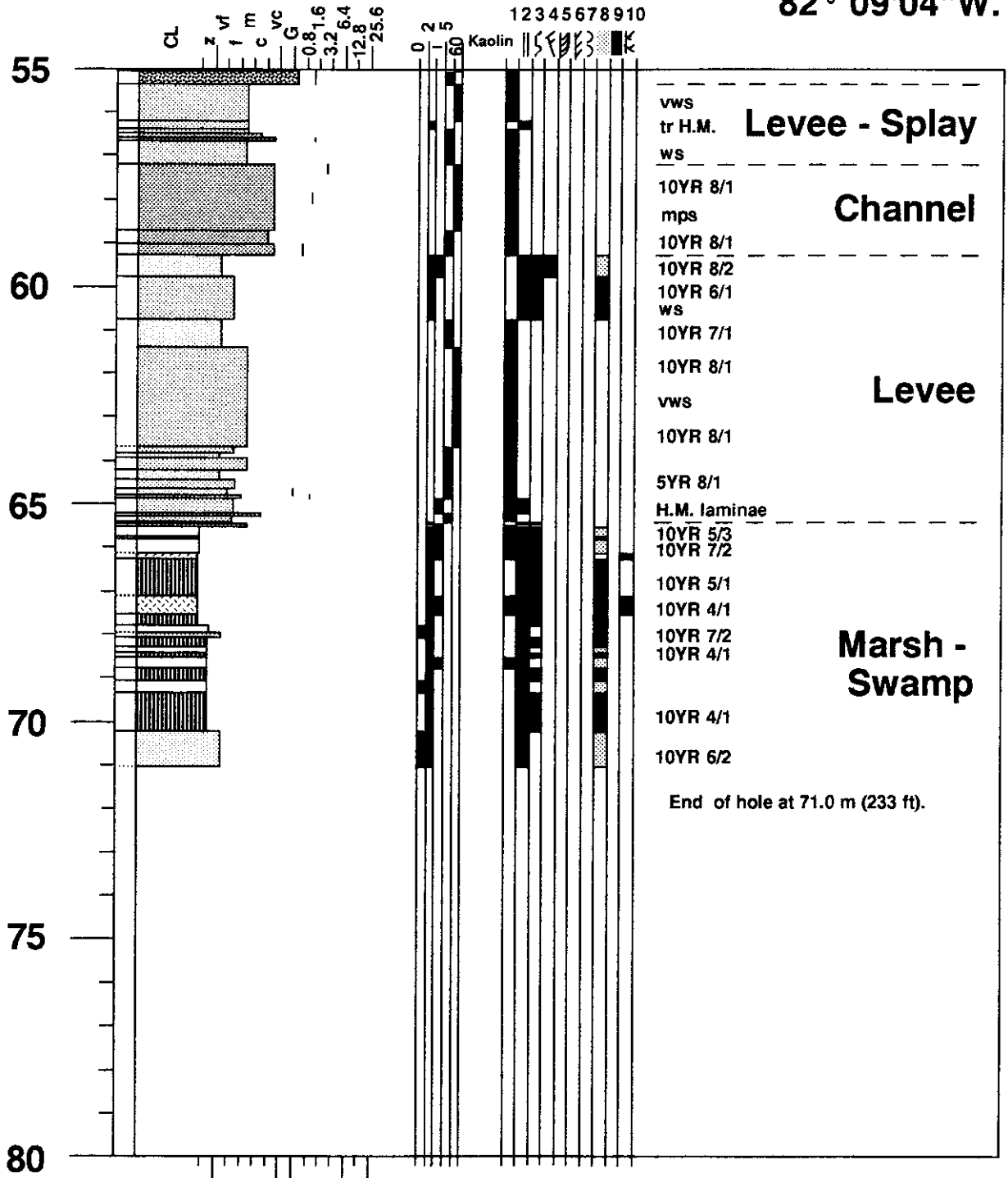
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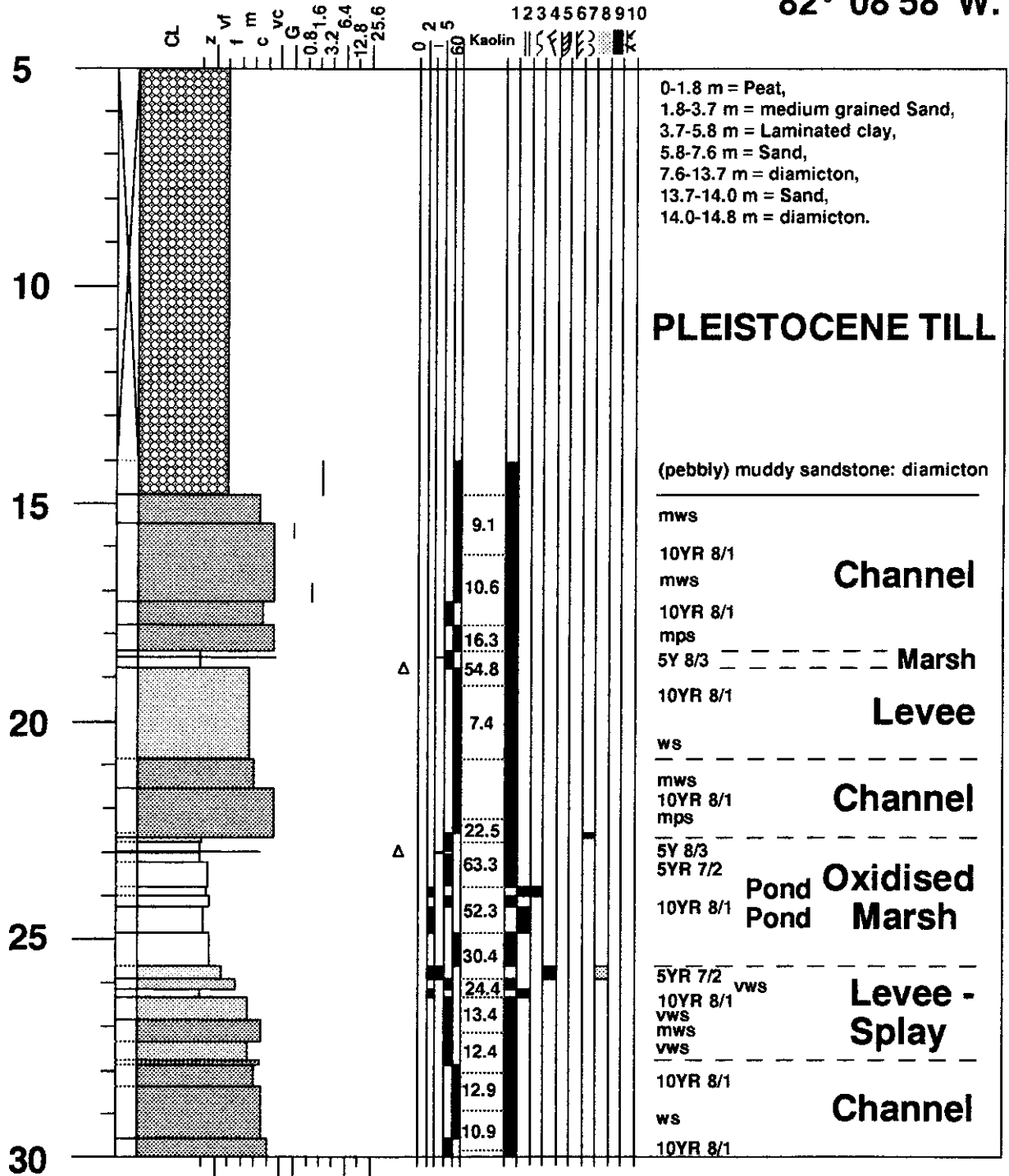
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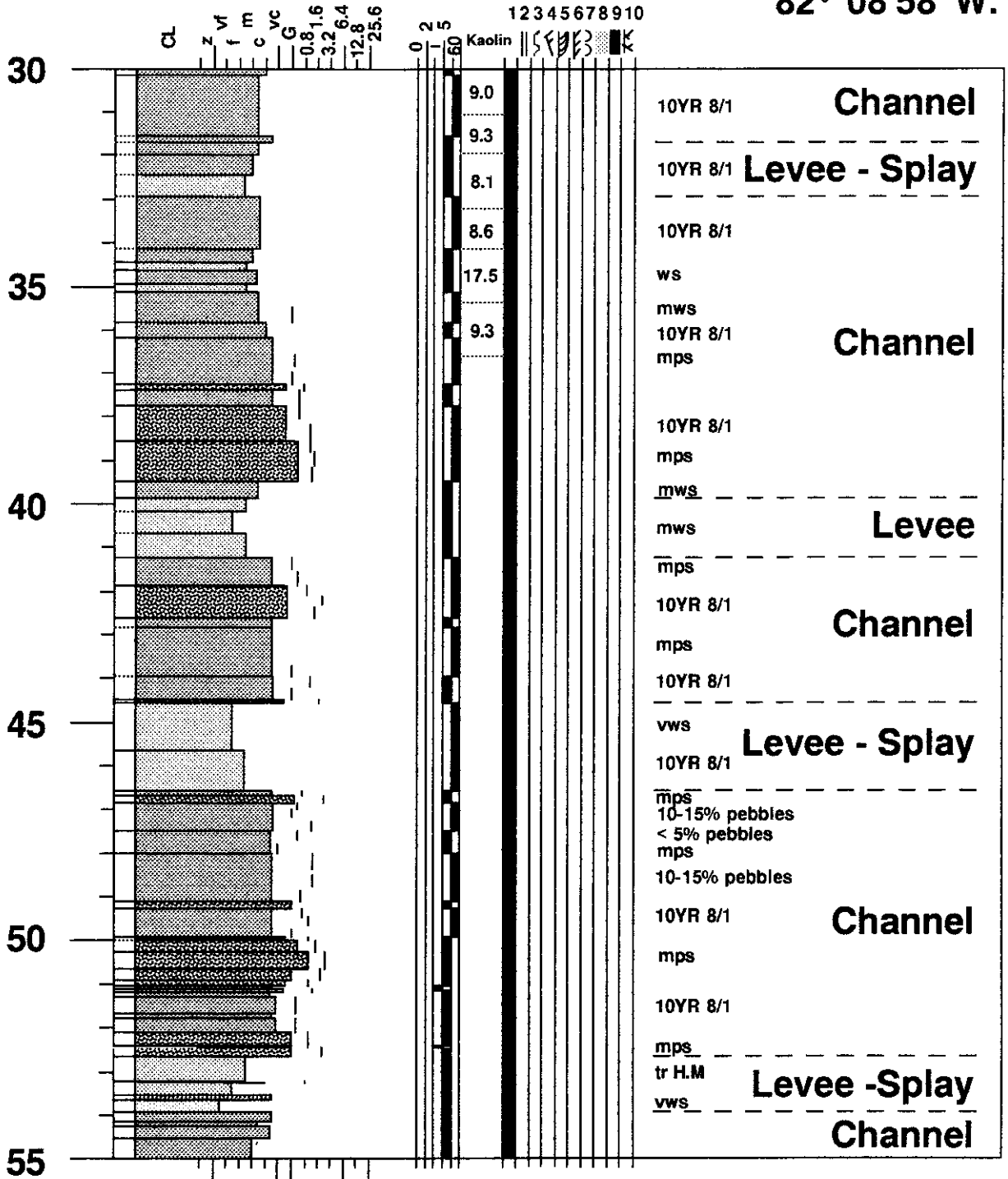
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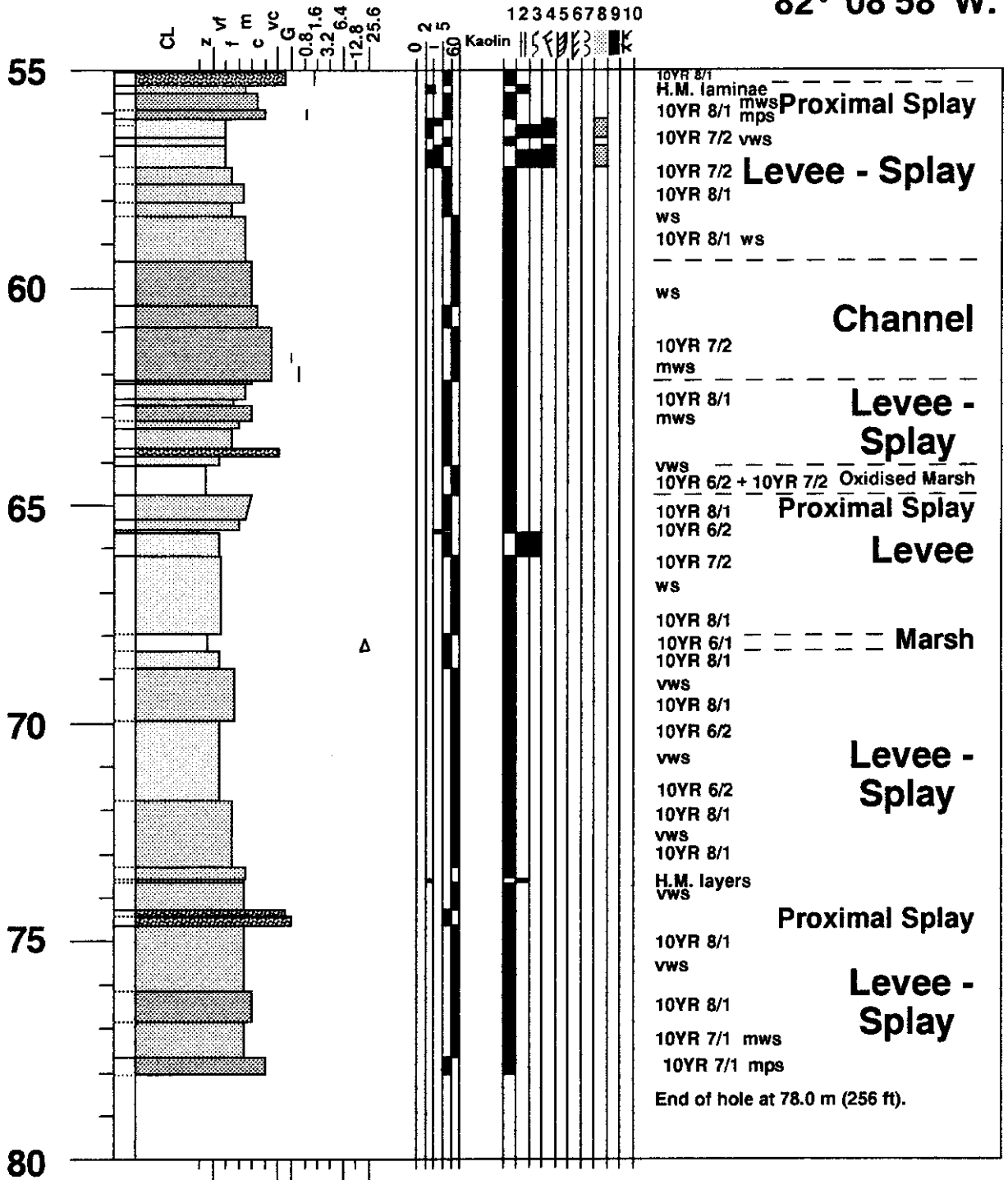
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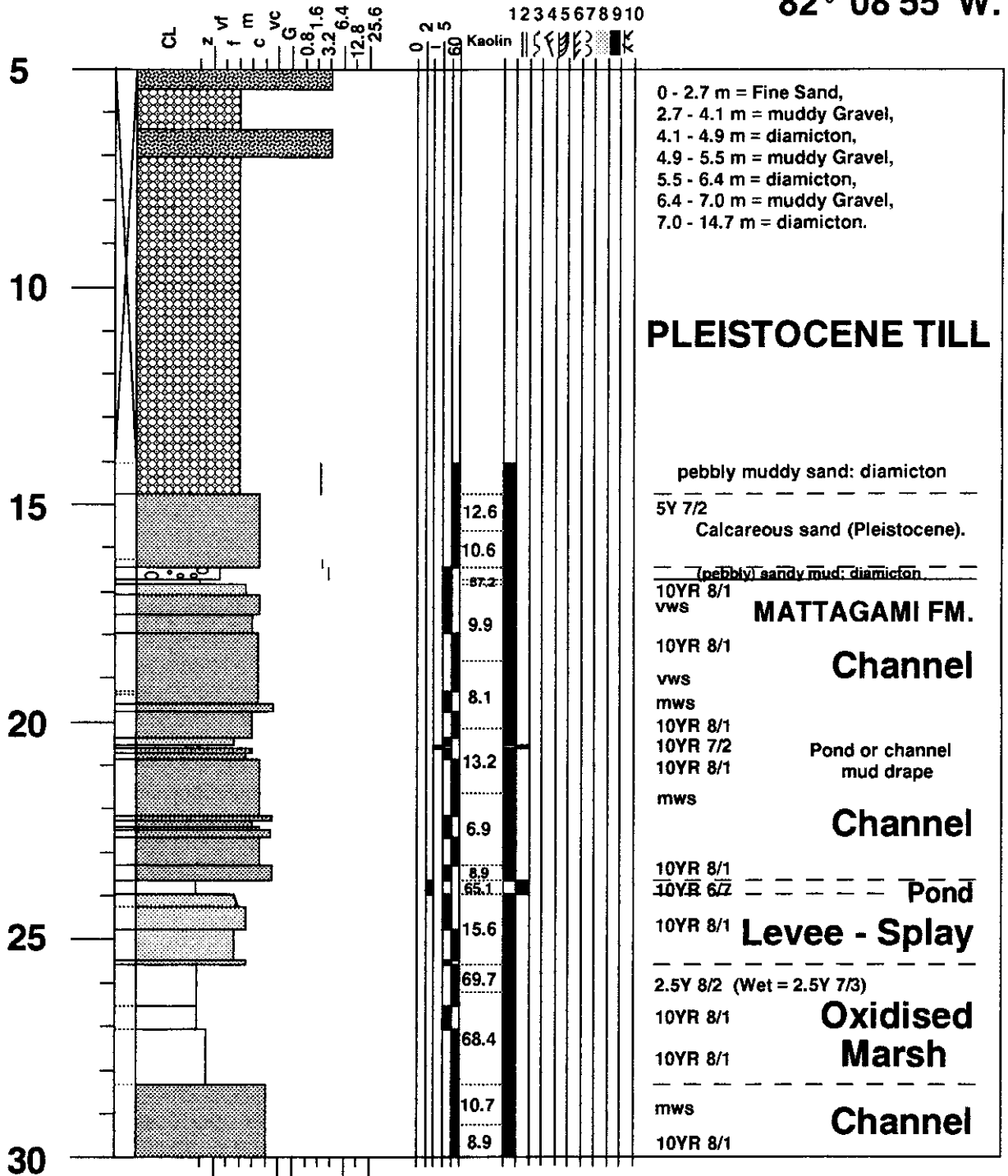
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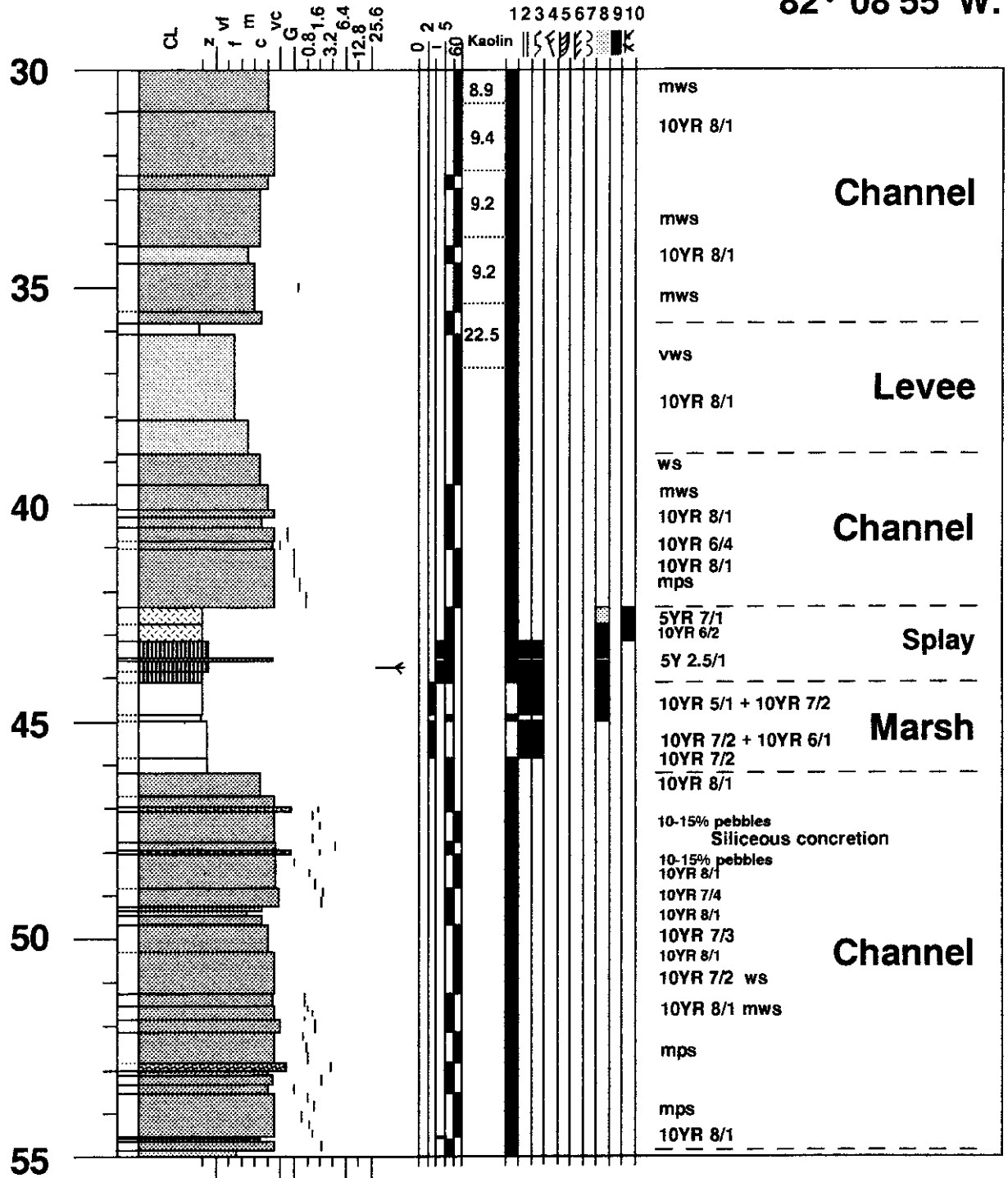
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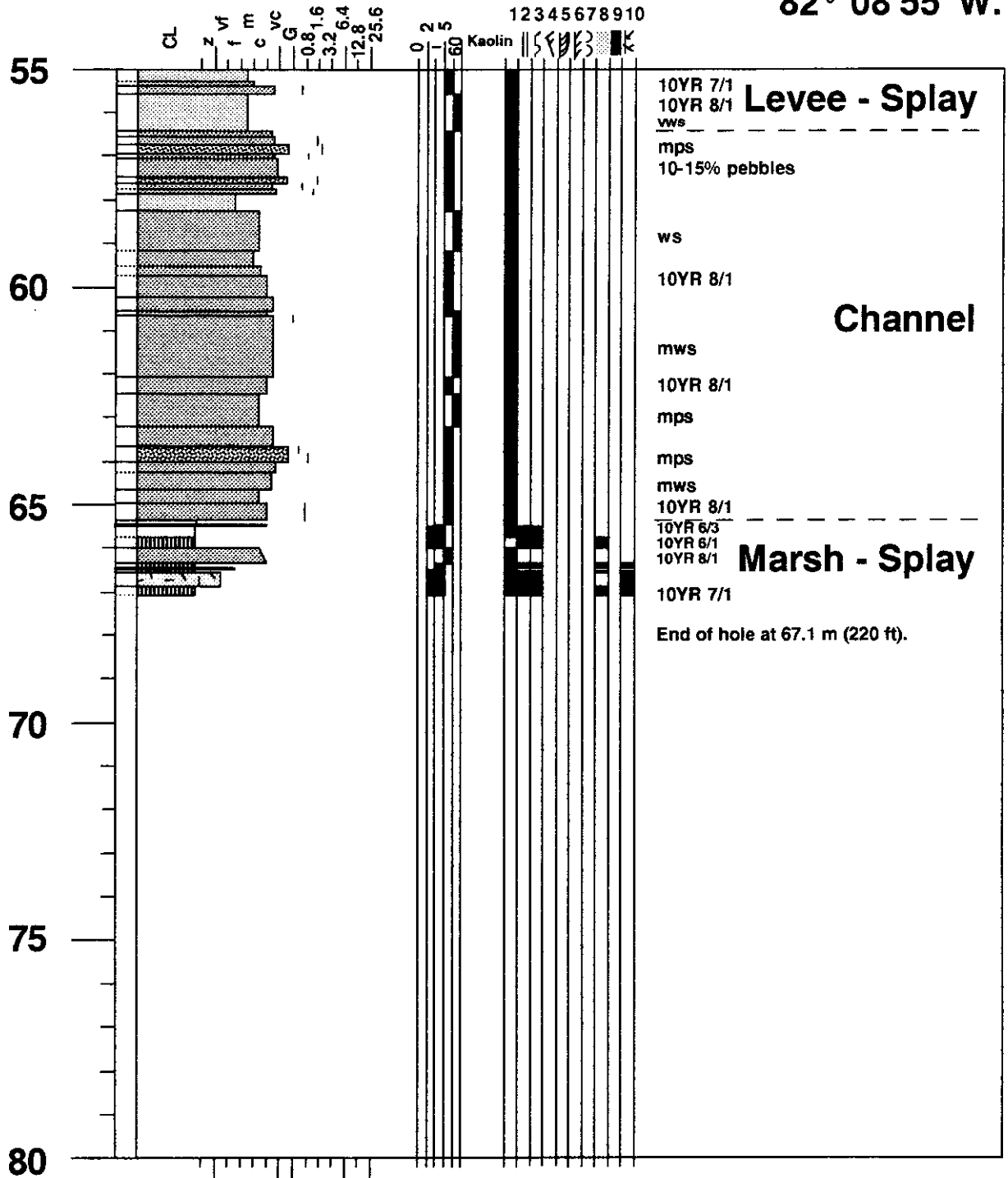
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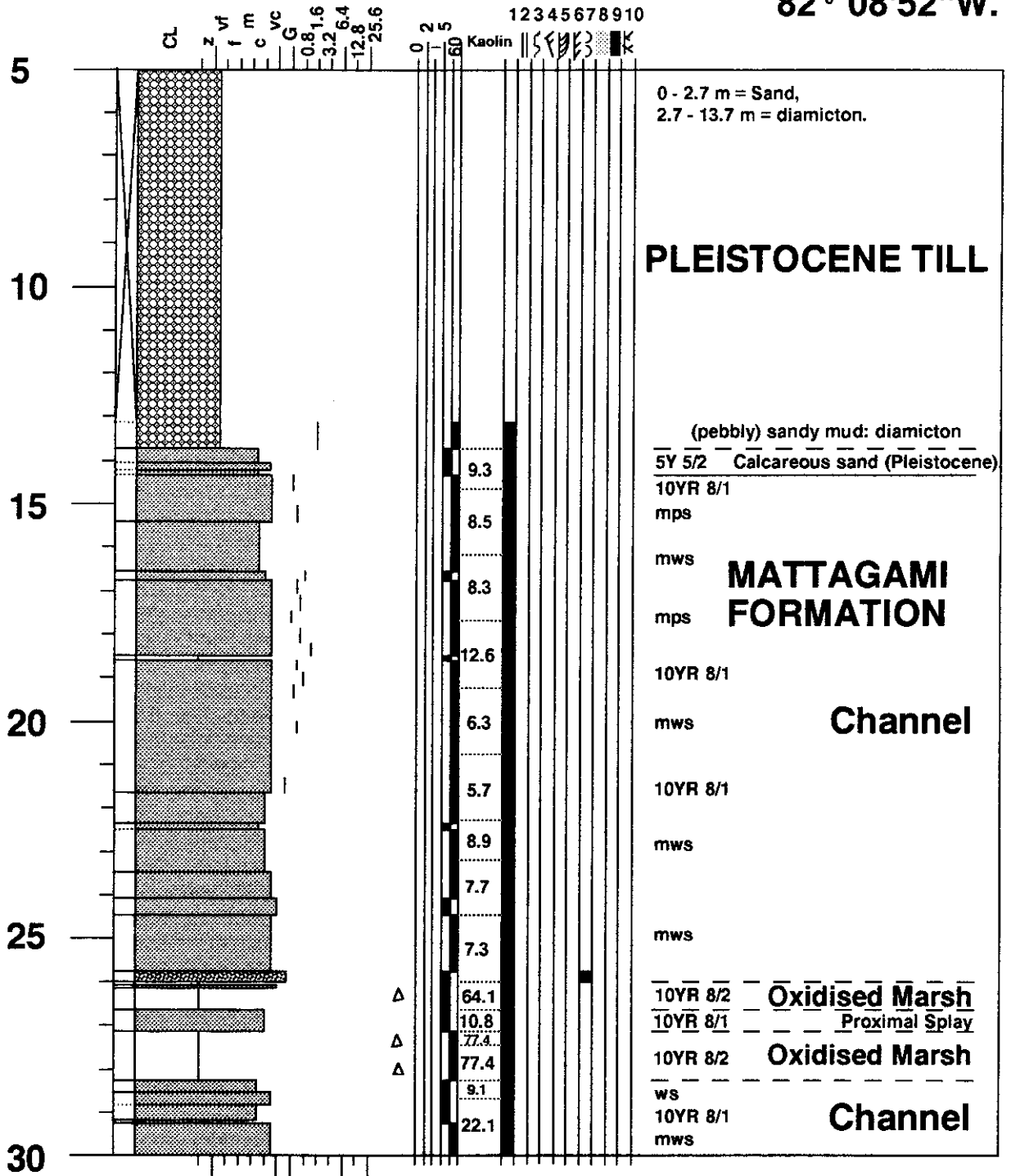
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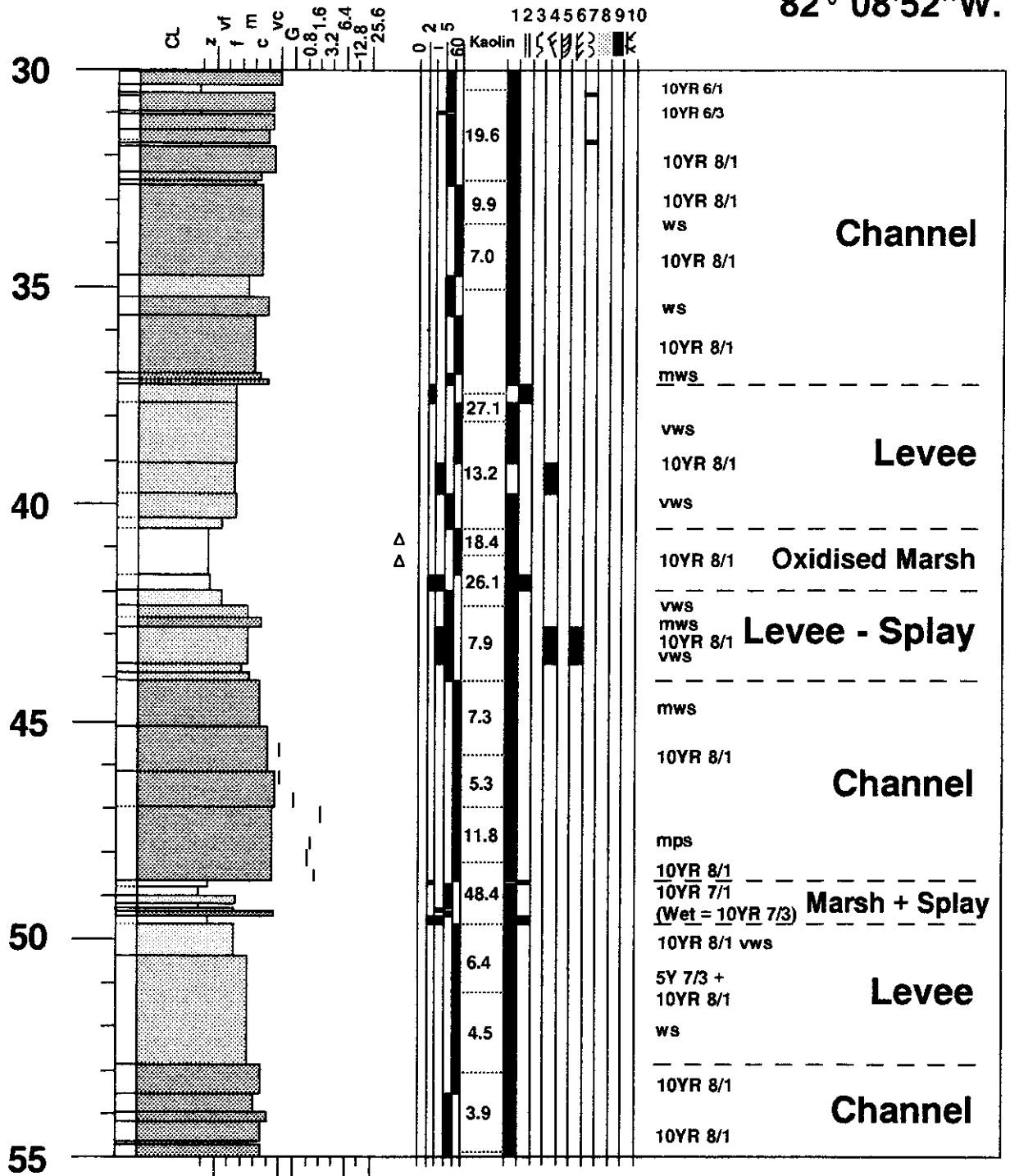
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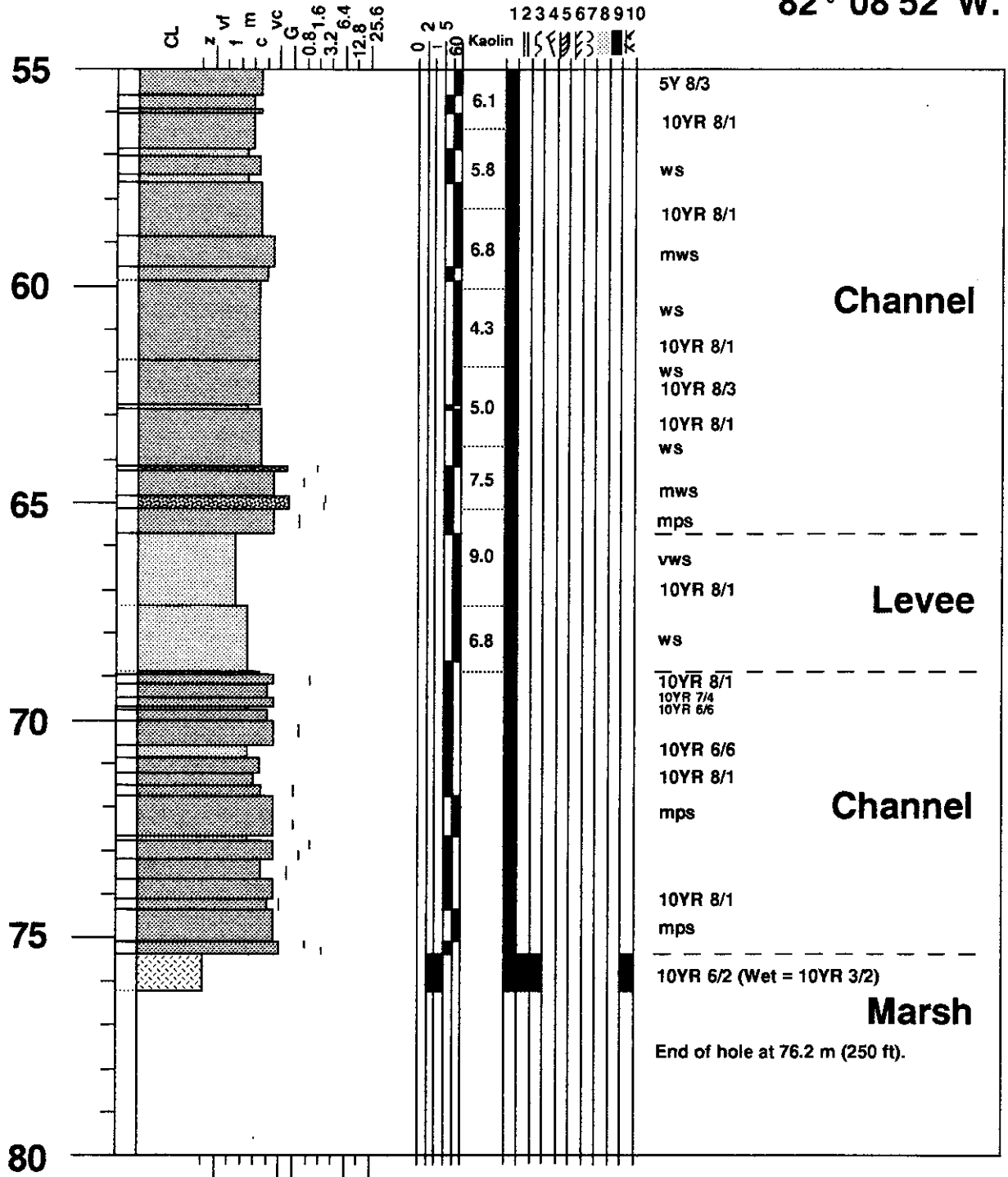
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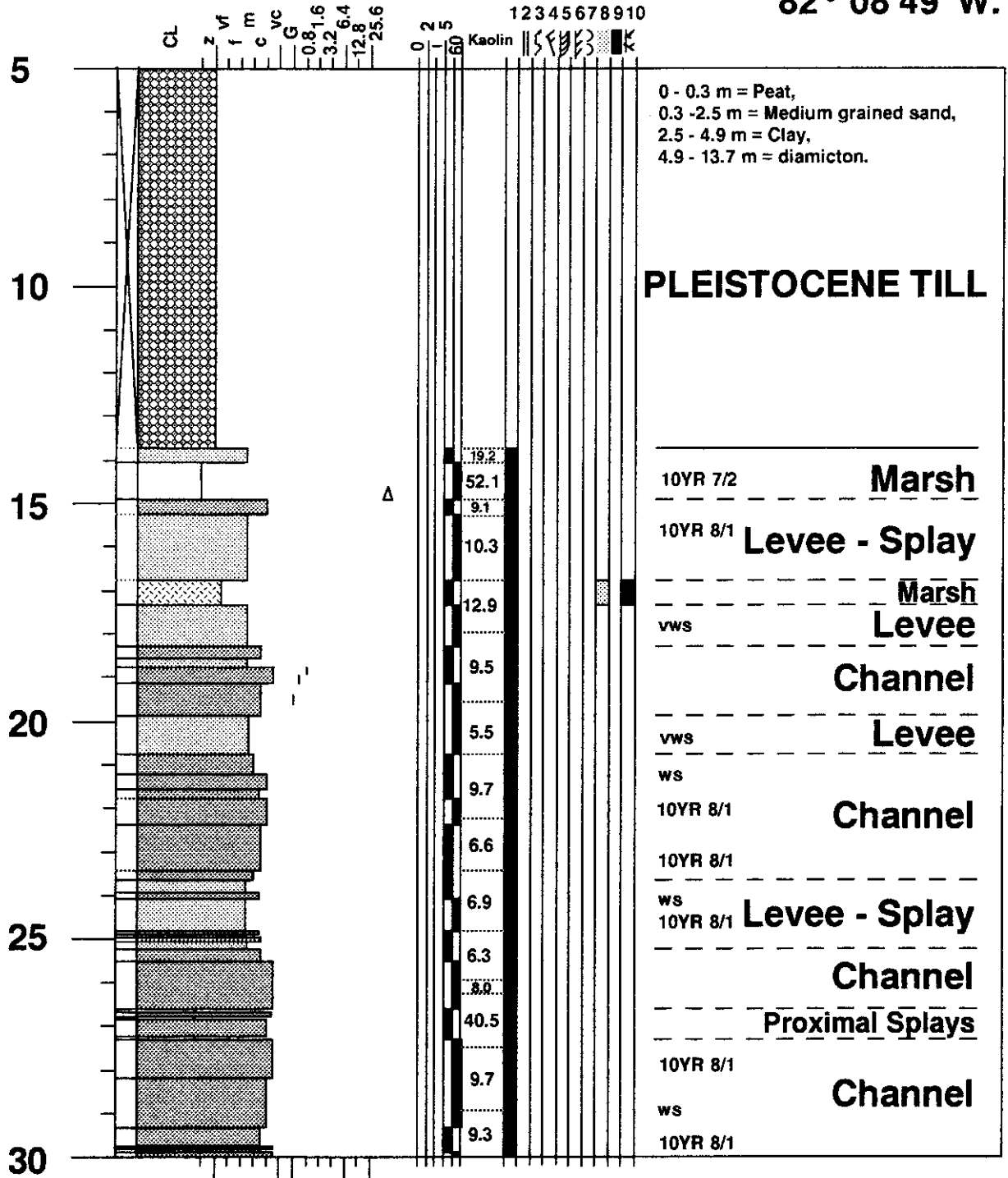
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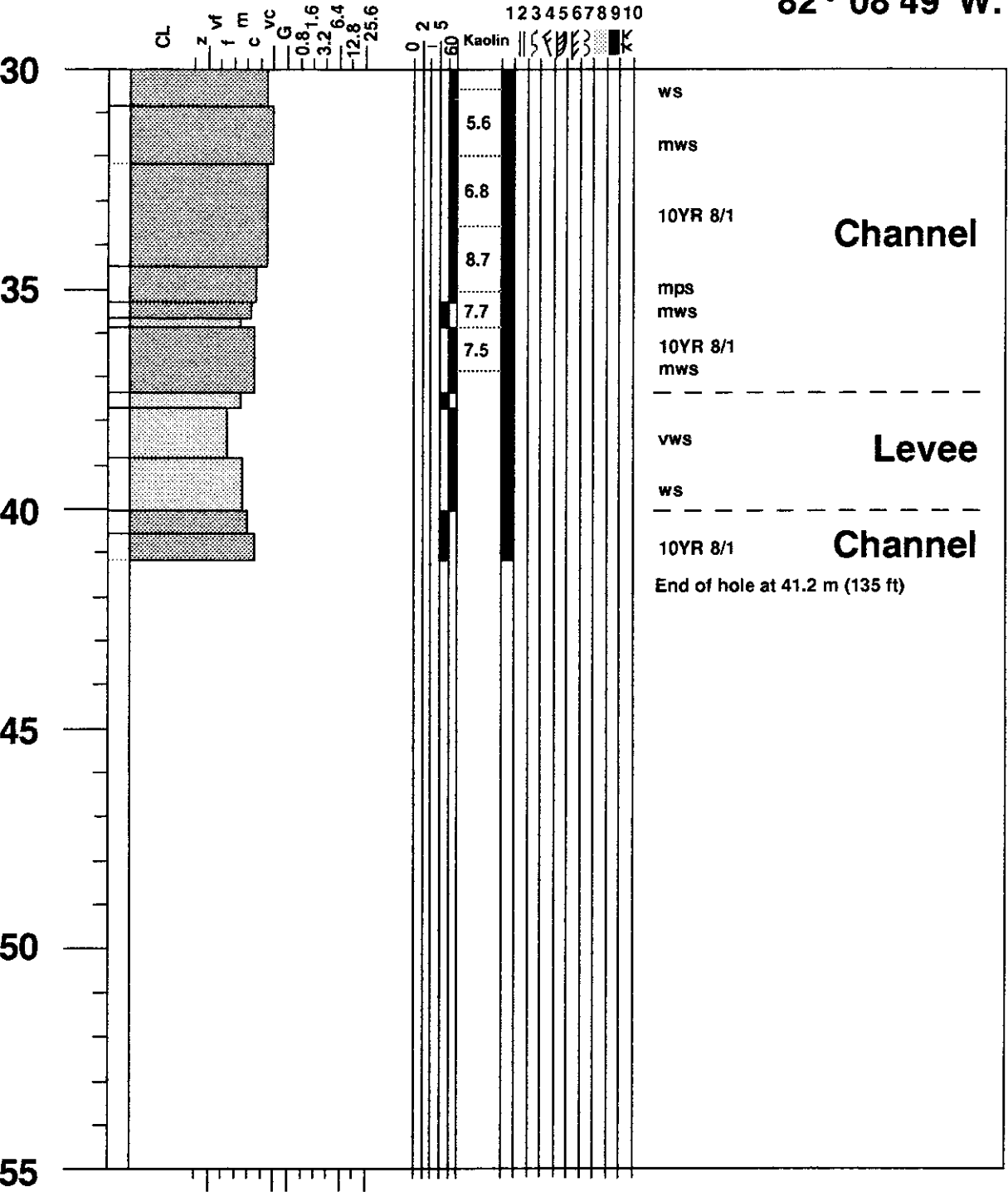
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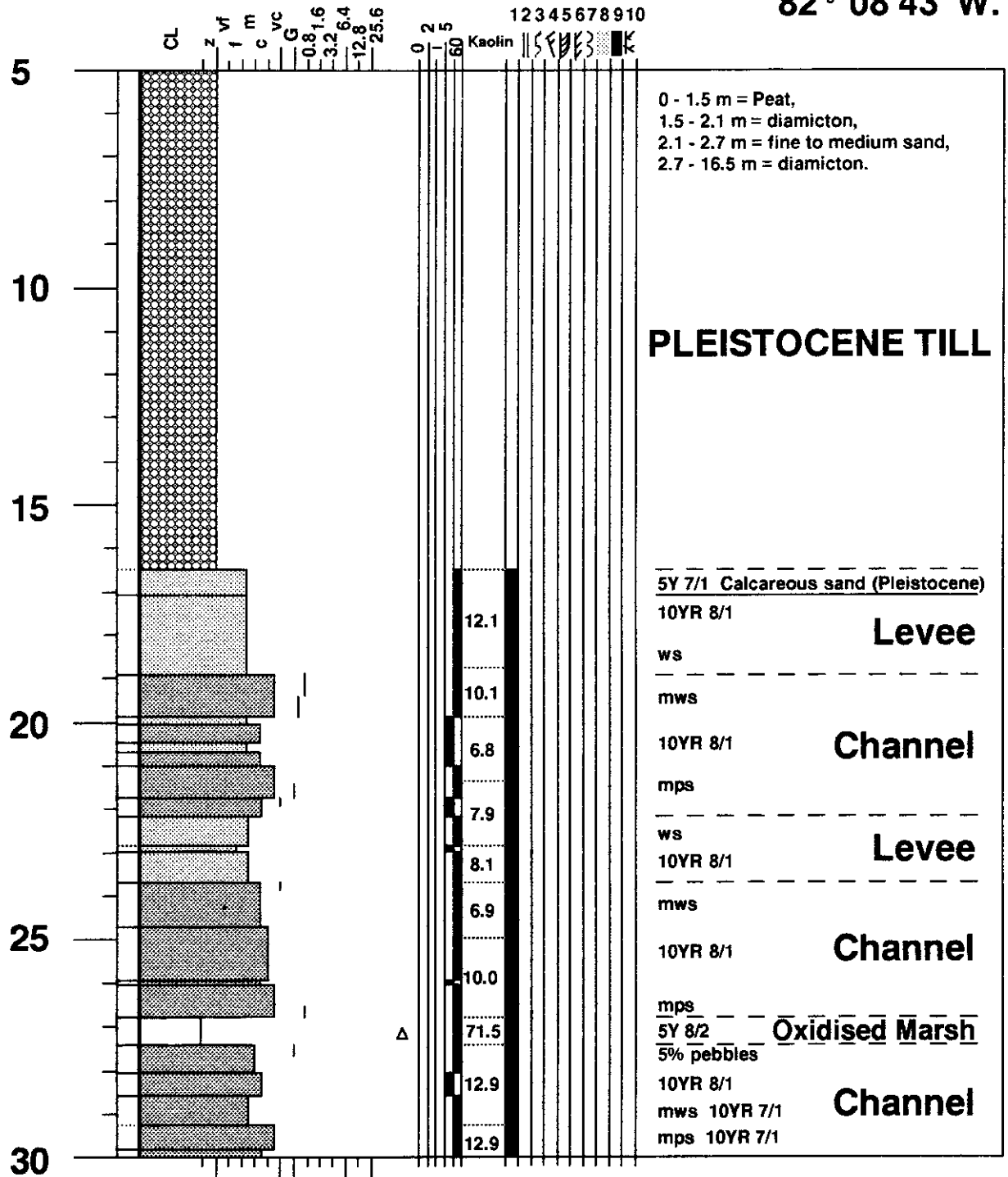
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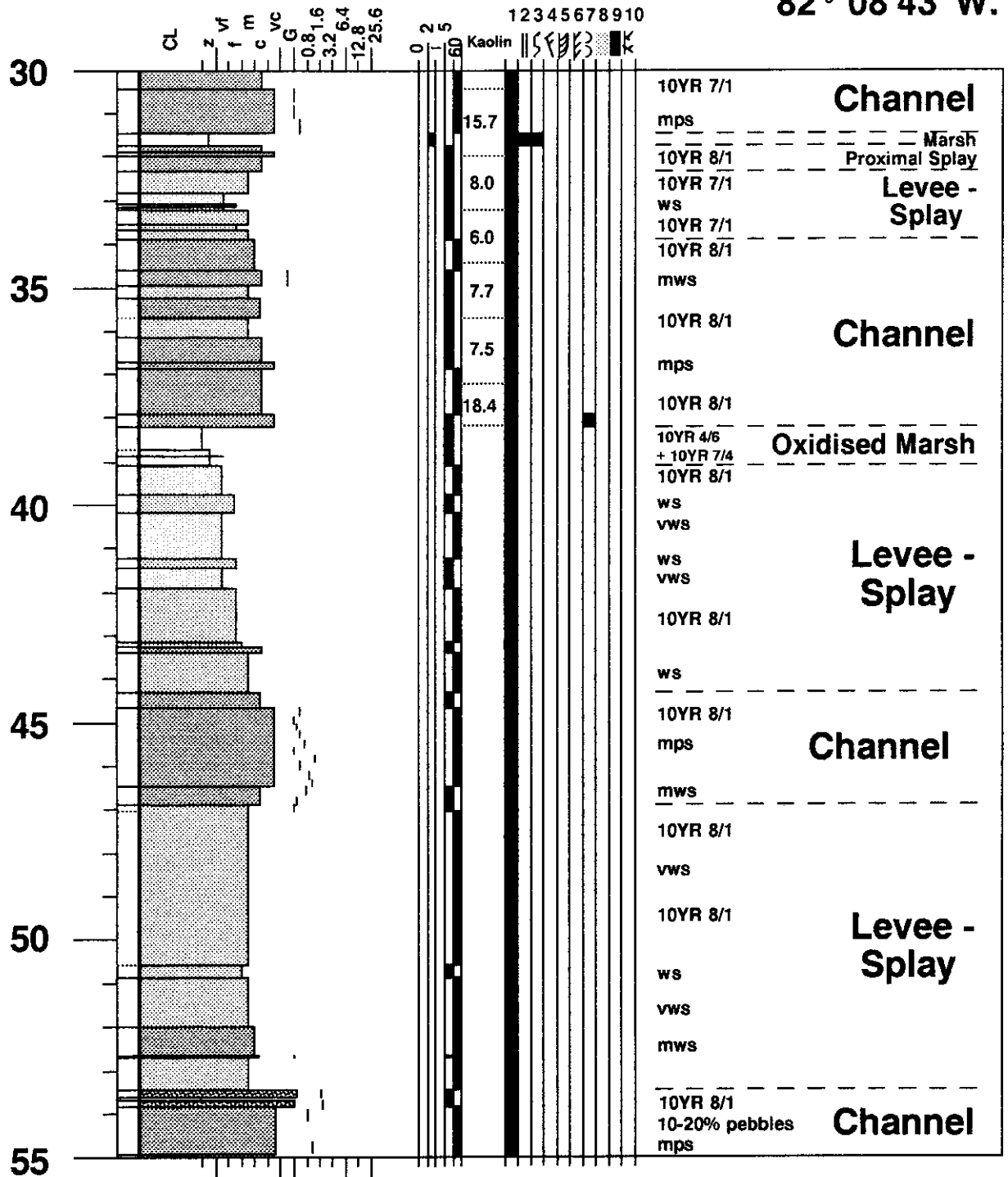
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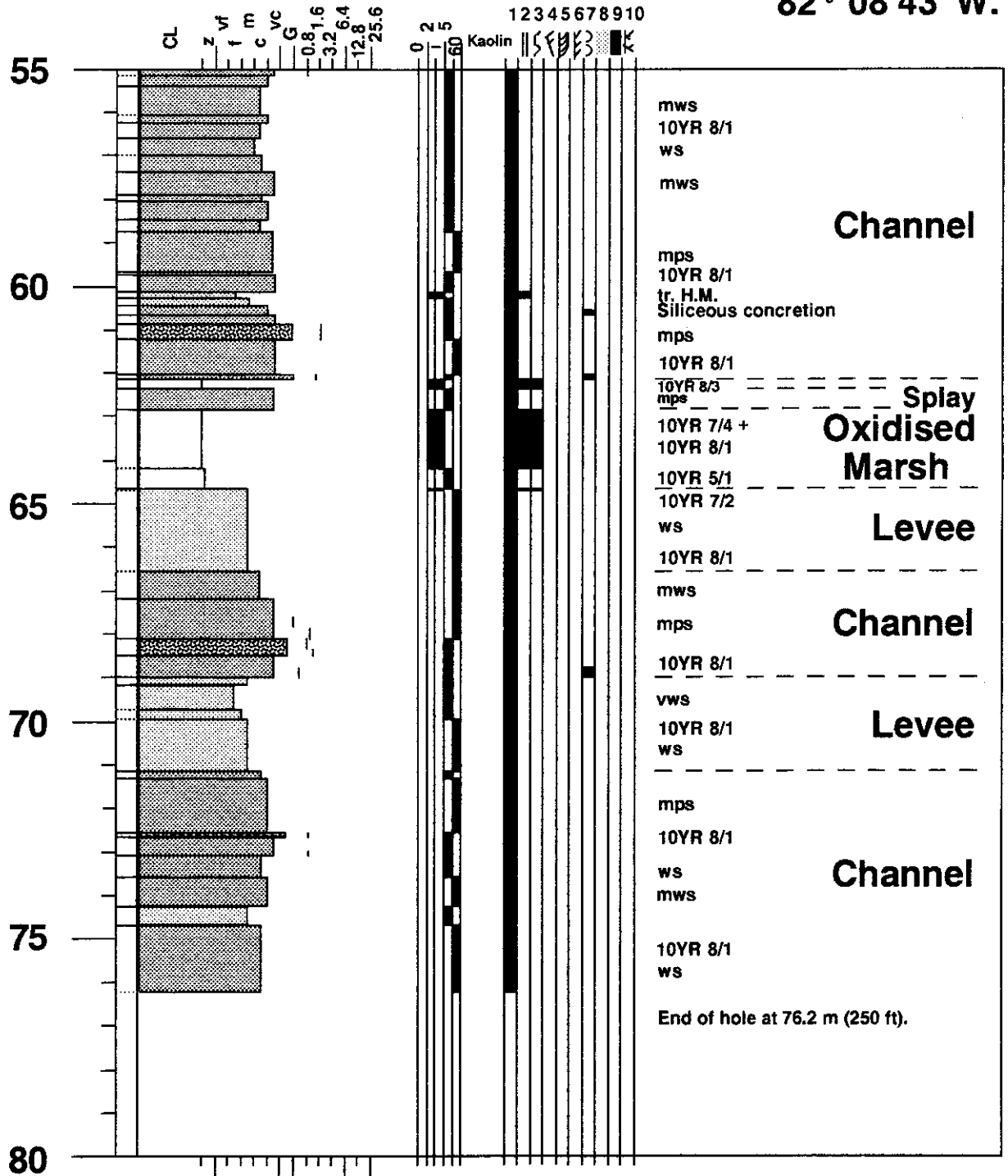
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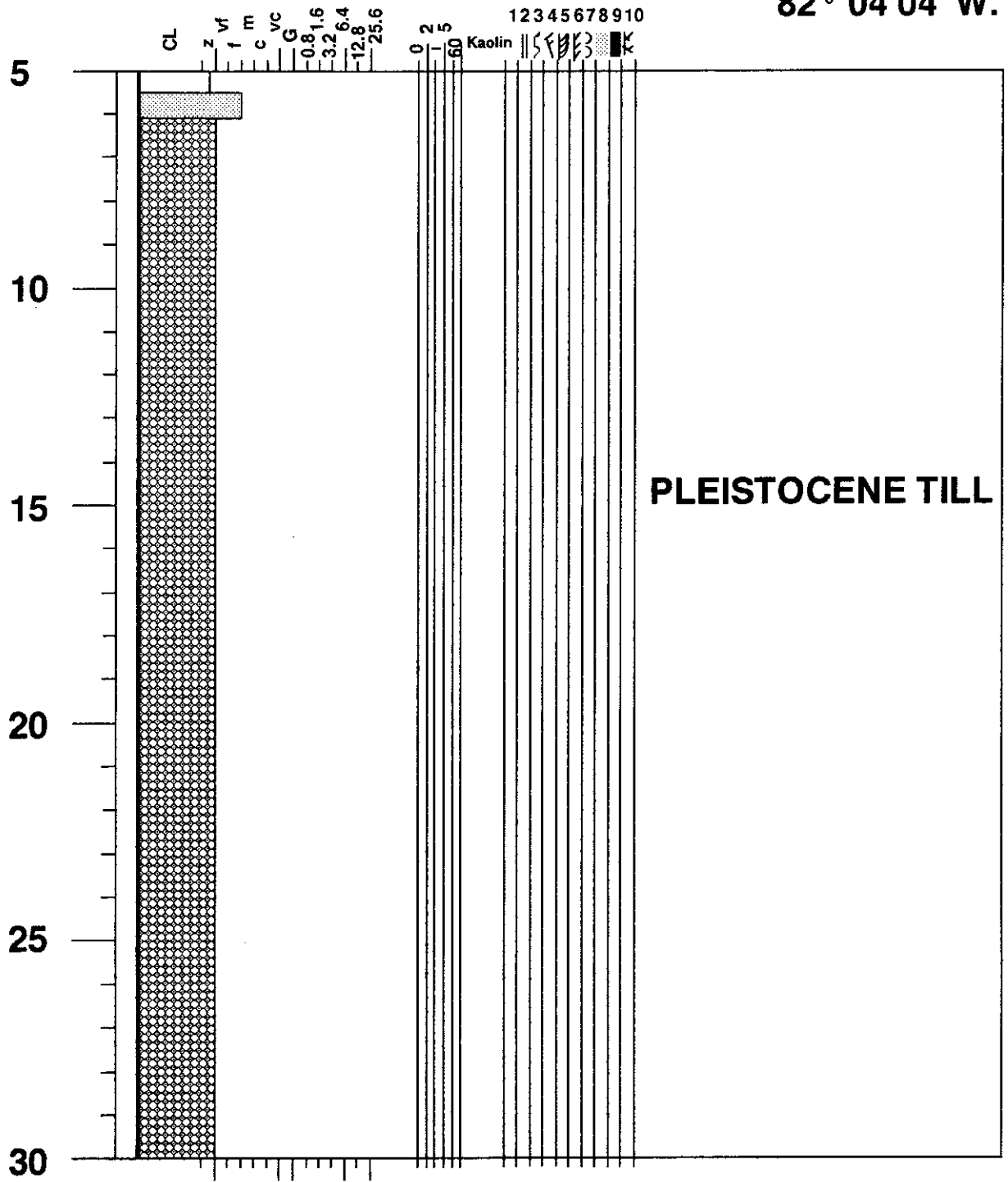
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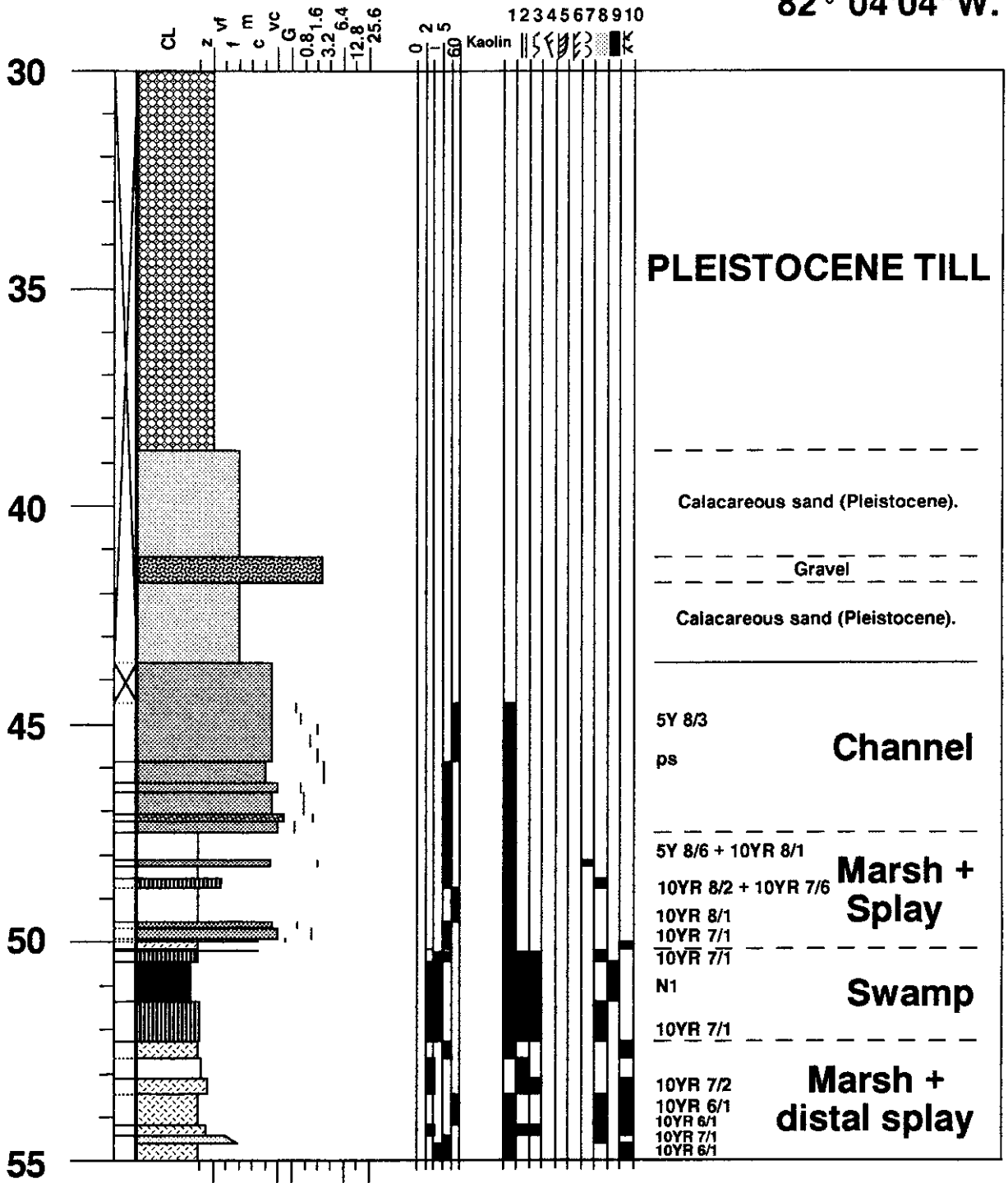
MRC hole 89 - 220, Kipling Twp.

50° 09'12"N,
82° 04'04"W.



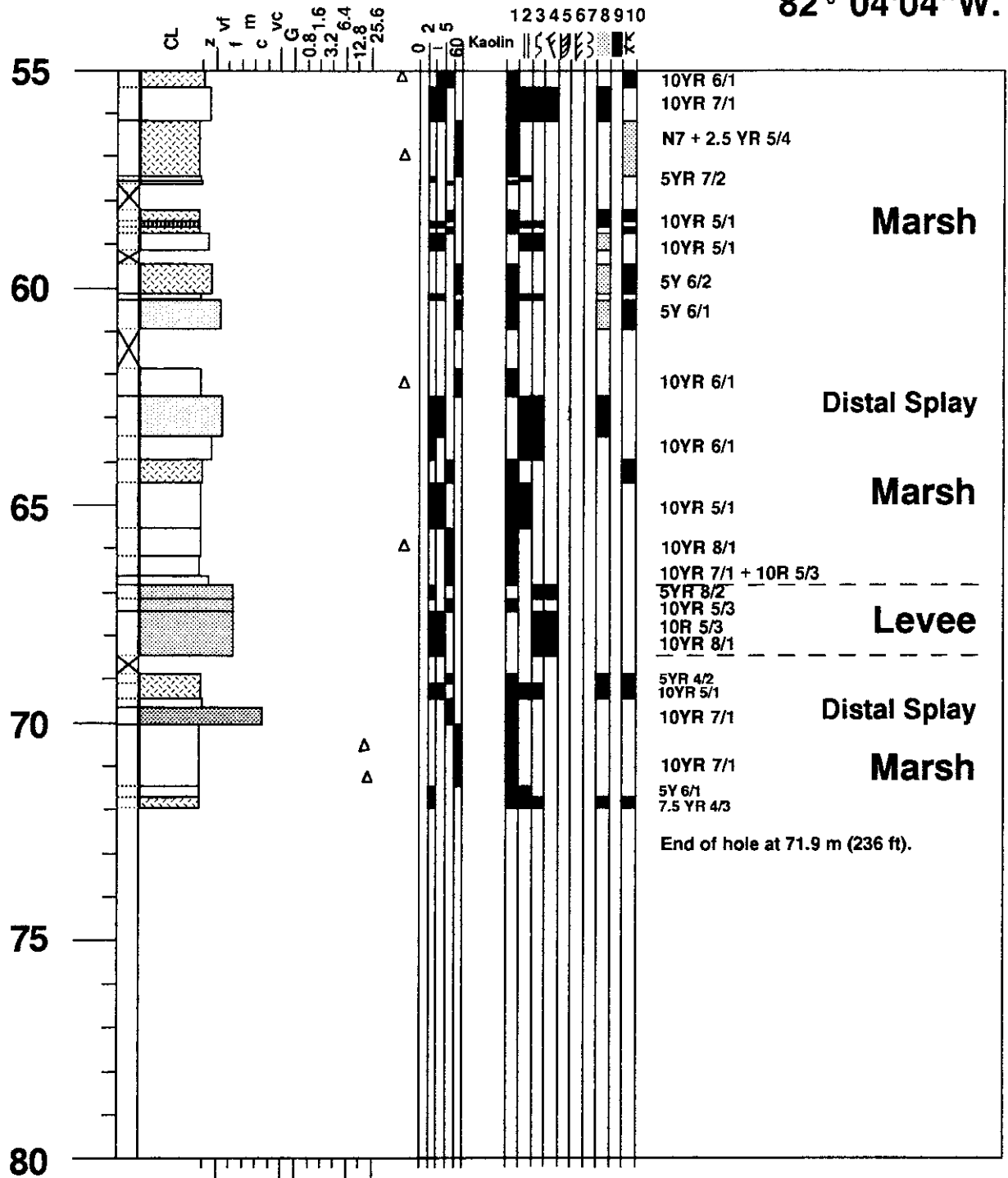
MRC hole 89 - 220, Kipling Twp.

50° 09'12"N,
82° 04'04"W.



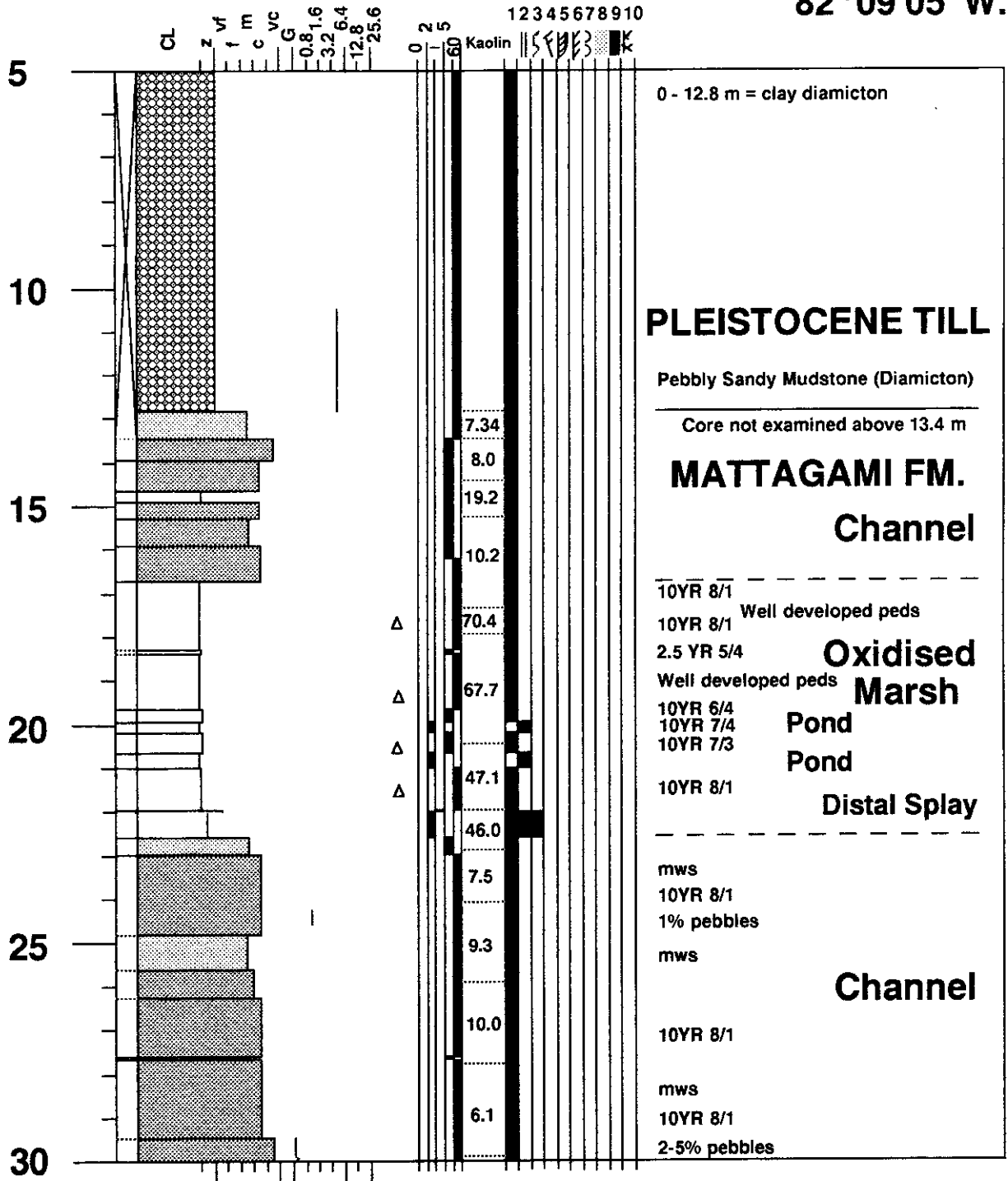
MRC hole 89 - 220, Kipling Twp.

50° 09'12"N,
82° 04'04"W.



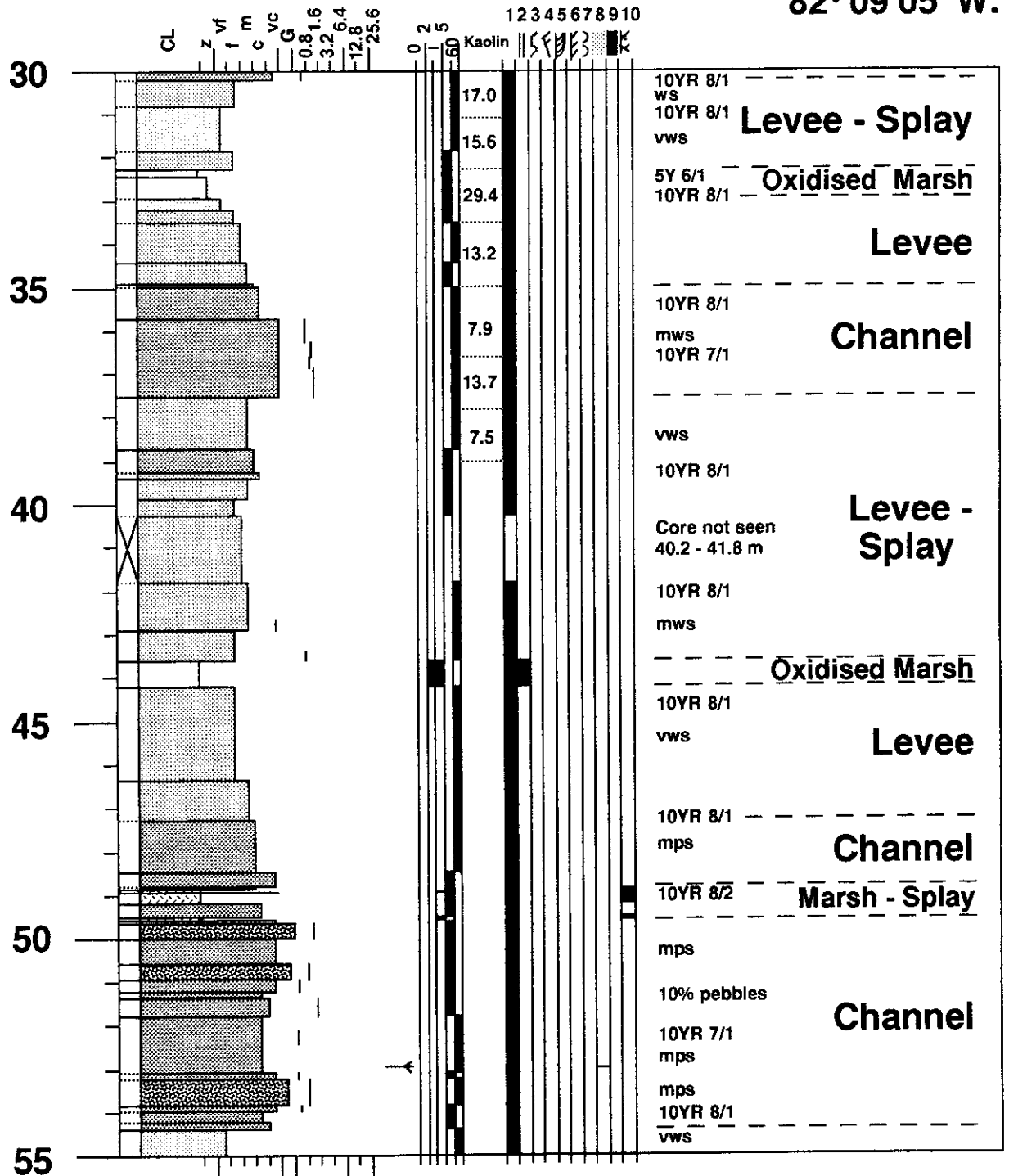
MRC hole 92-9, Kipling Twp.

50° 08'57"N,
82° 09'05"W.



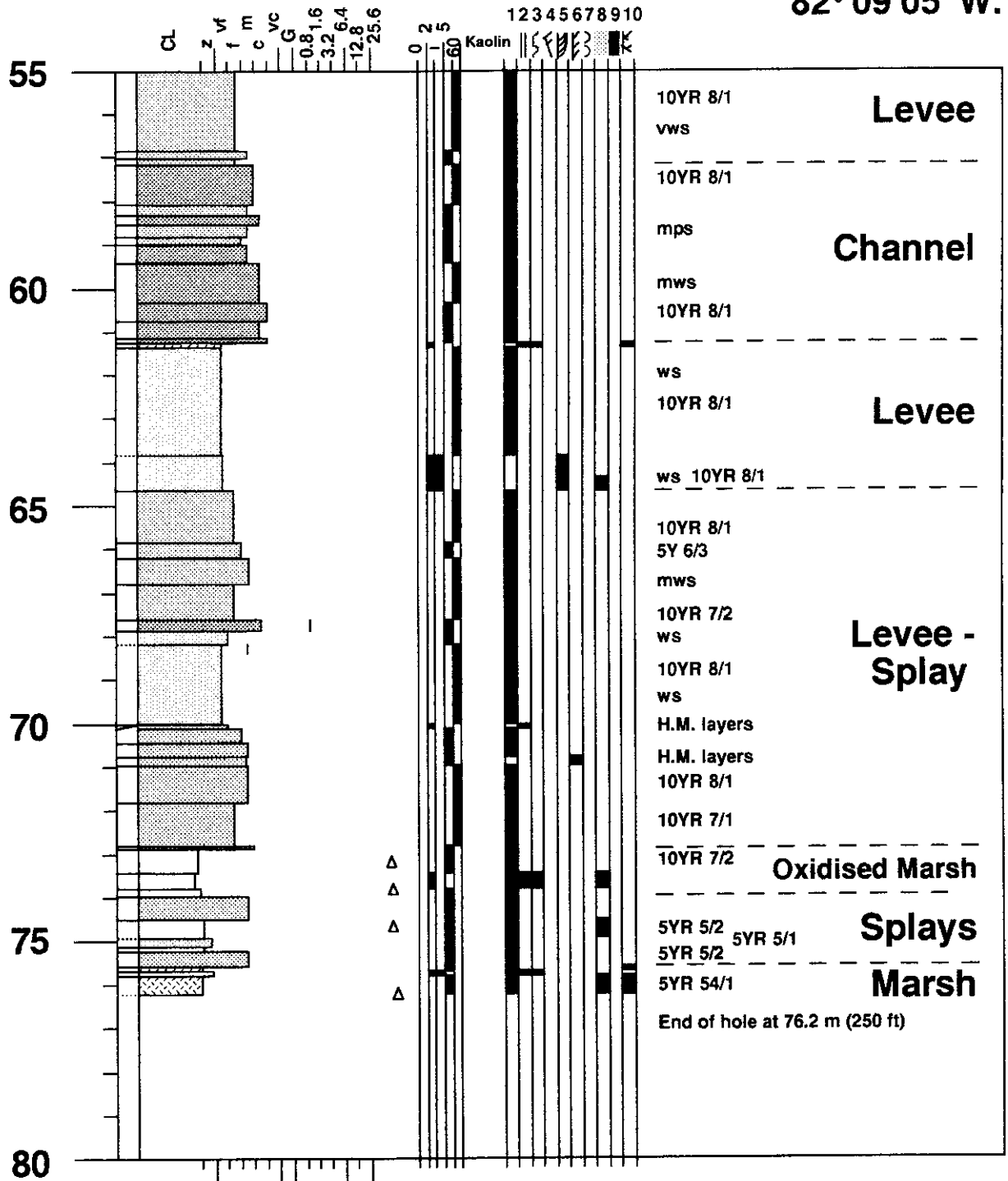
MRC hole 92-9, Kipling Twp.

50° 08'57"N,
82° 09'05"W.



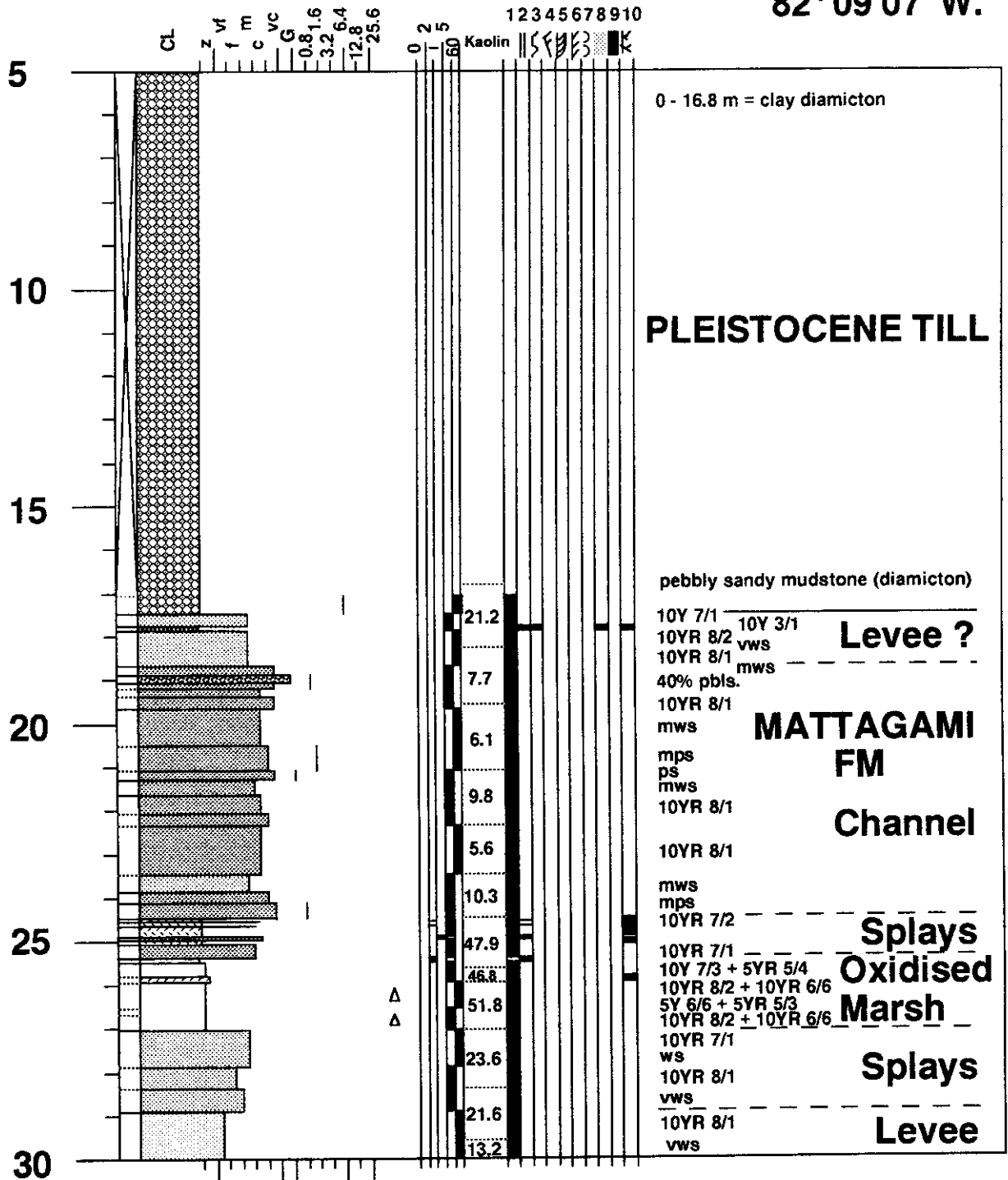
MRC hole 92-9, Kipling Twp.

50° 08'57"N,
82° 09'05"W.



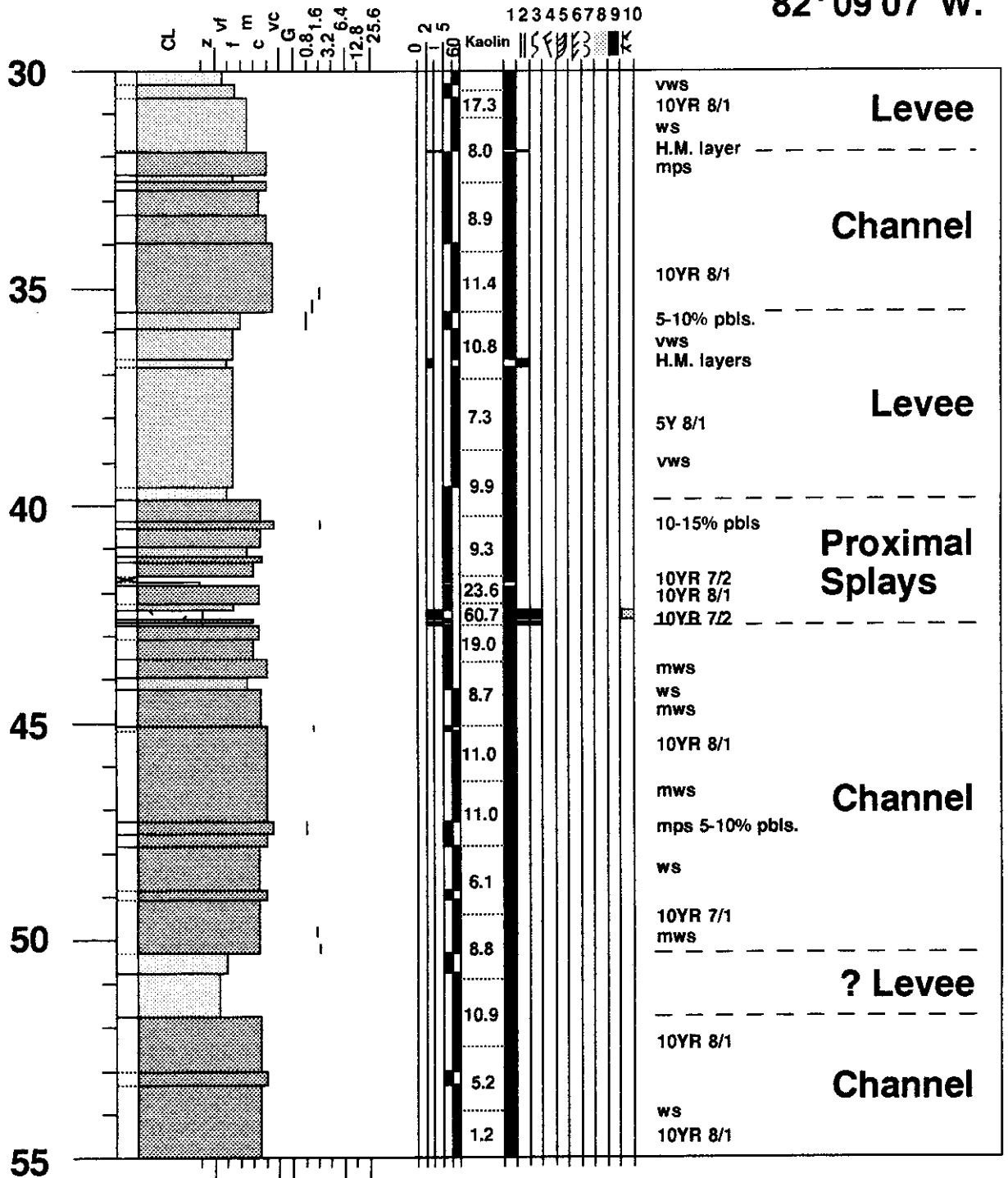
MRC hole 92-10, Kipling Twp.

50° 08'58"N,
82° 09'07"W.



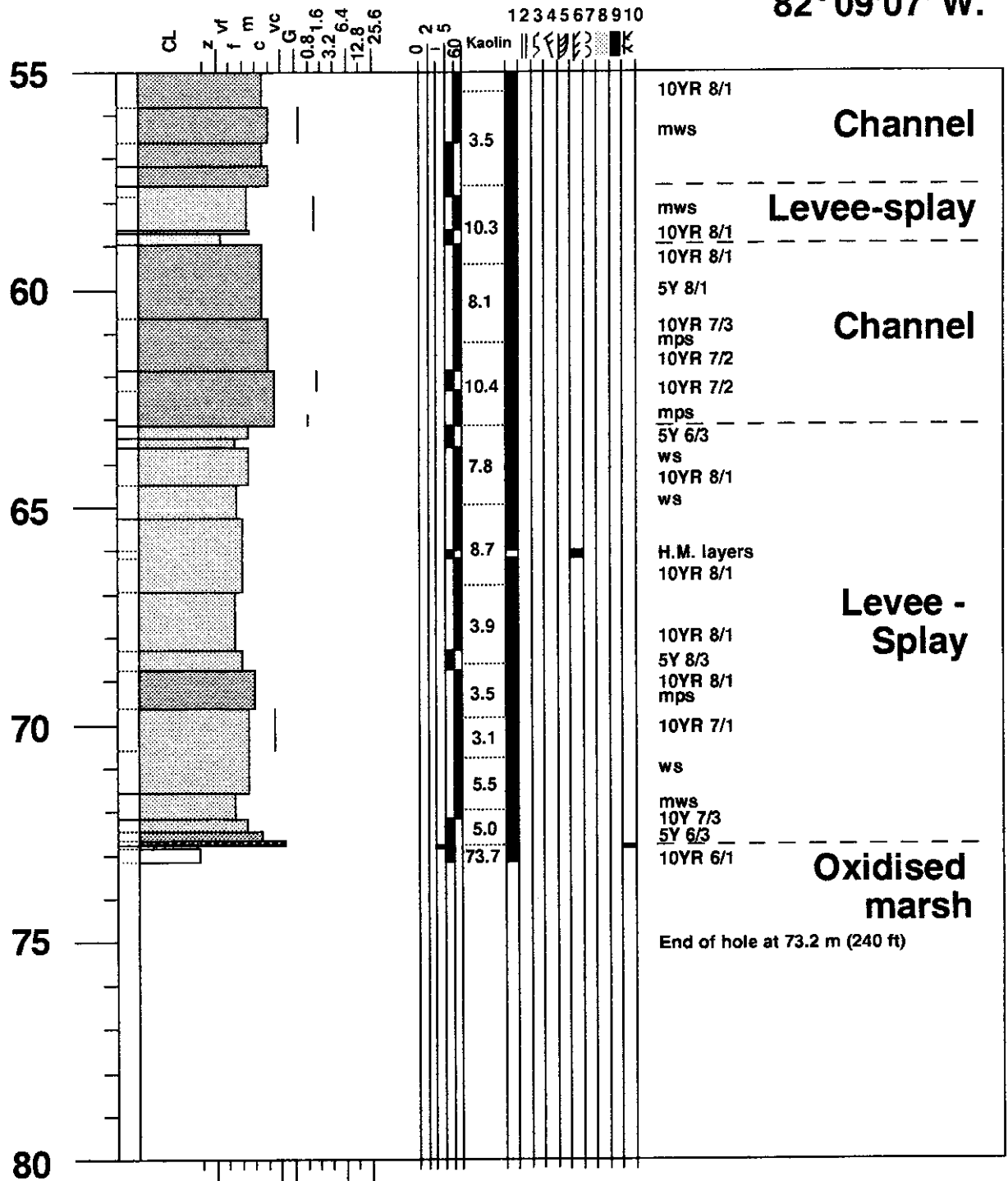
MRC hole 92-10, Kipling Twp.

50° 08'58"N,
82° 09'07"W.



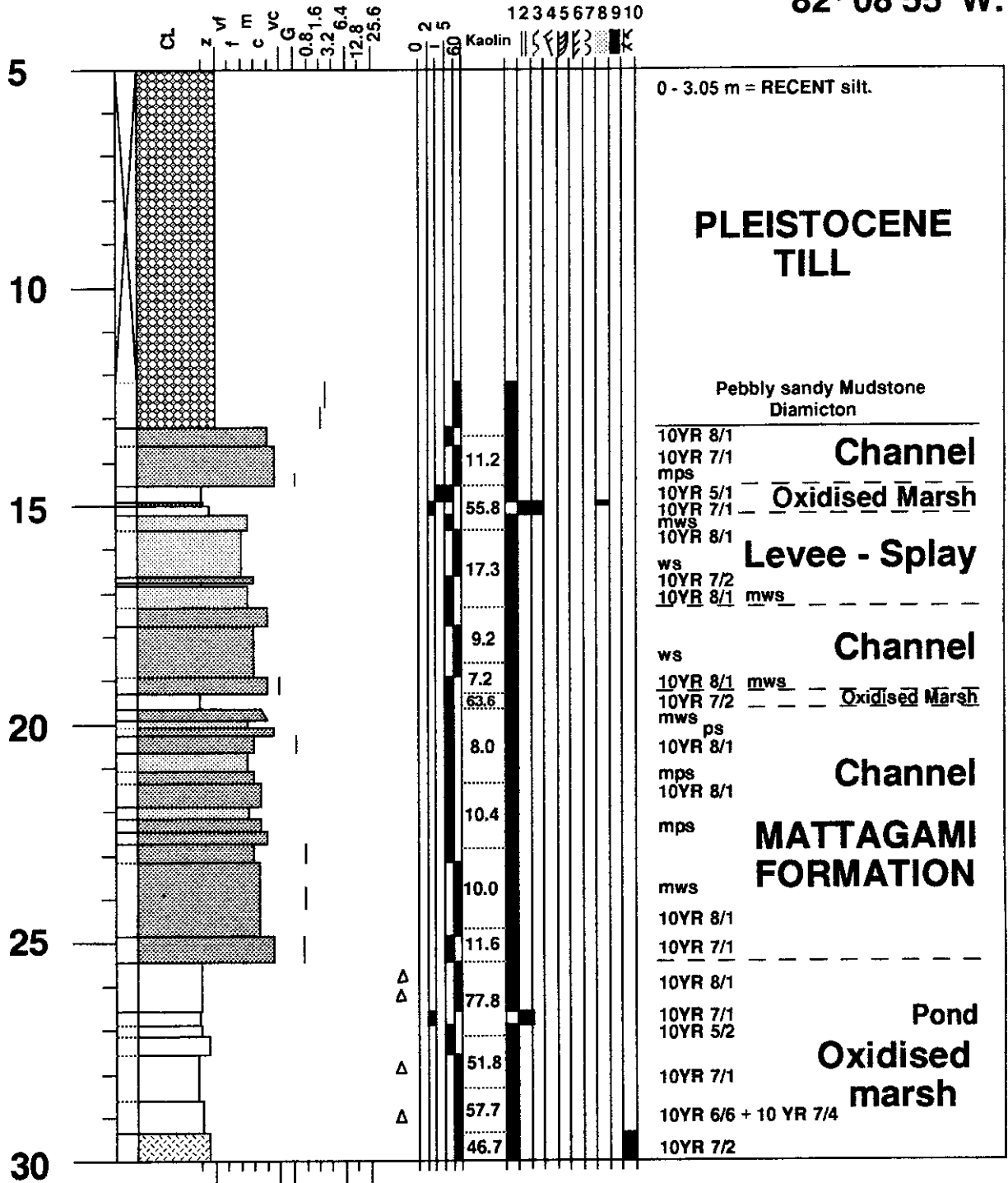
MRC hole 92-10, Kipling Twp.

50° 08'58"N,
82° 09'07"W.



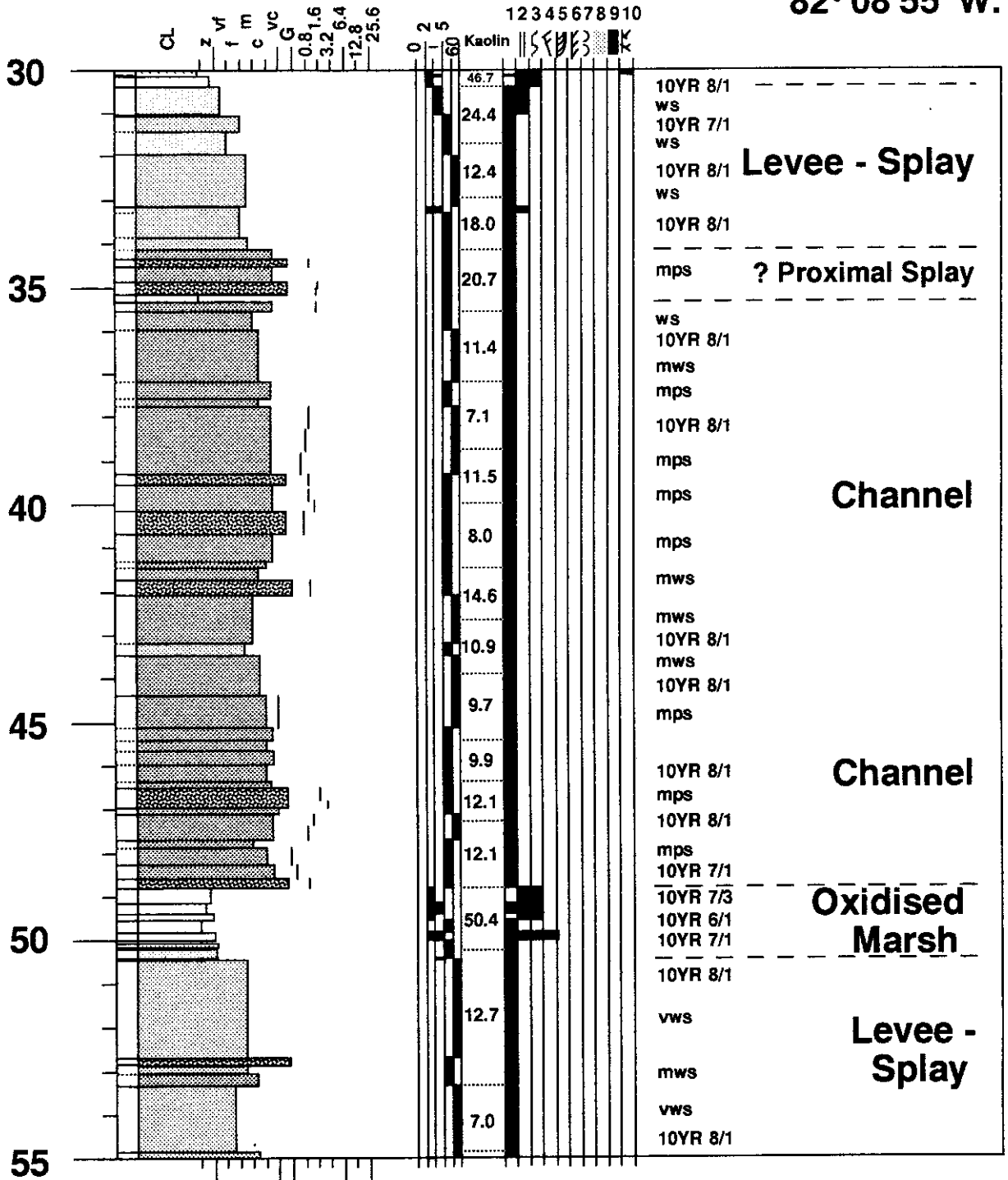
MRC hole 92-13, Kipling Twp.

50° 08'57"N,
82° 08'55"W.



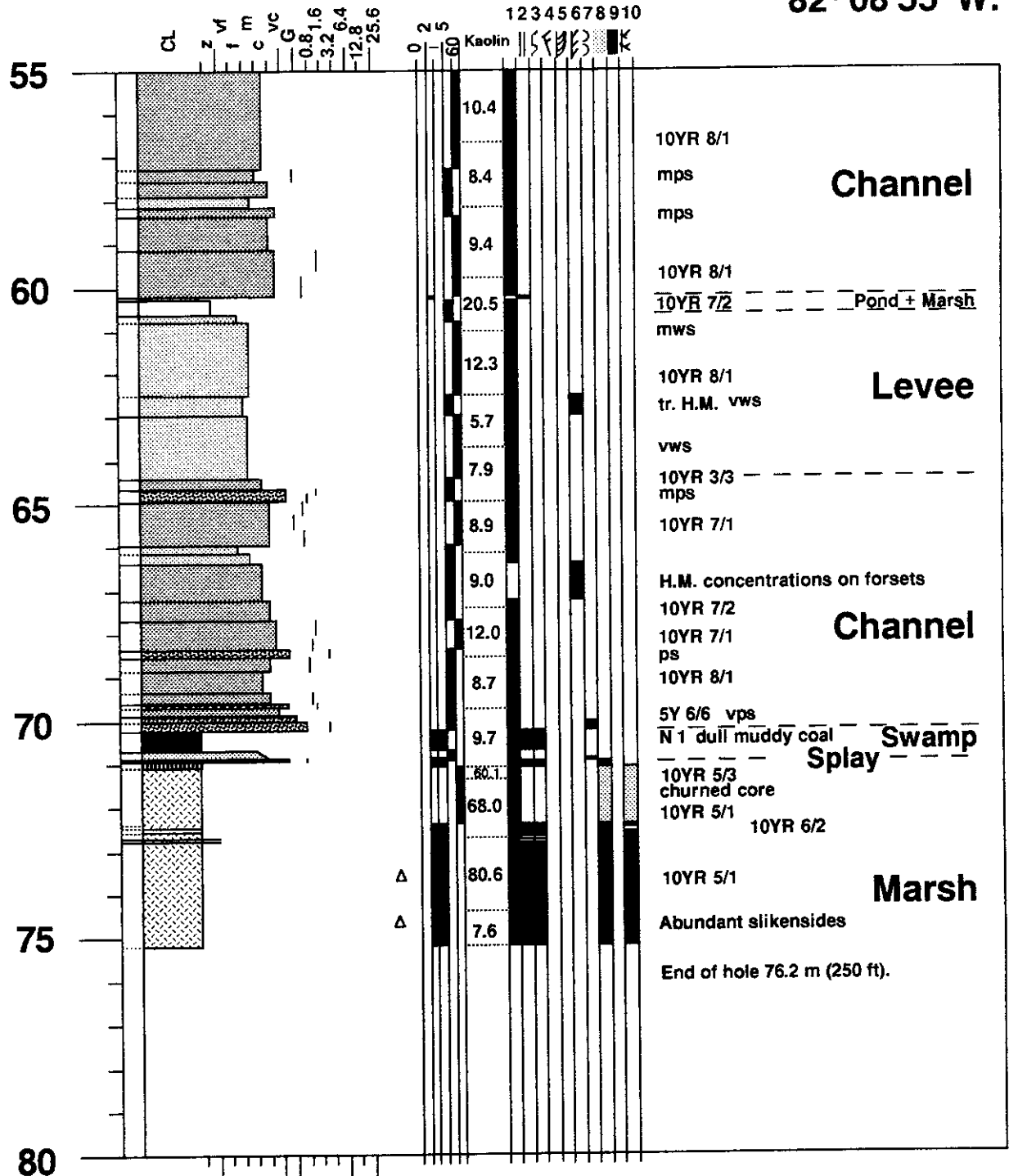
MRC hole 92-13, Kipling Twp.

50° 08'57"N,
82° 08'55"W.



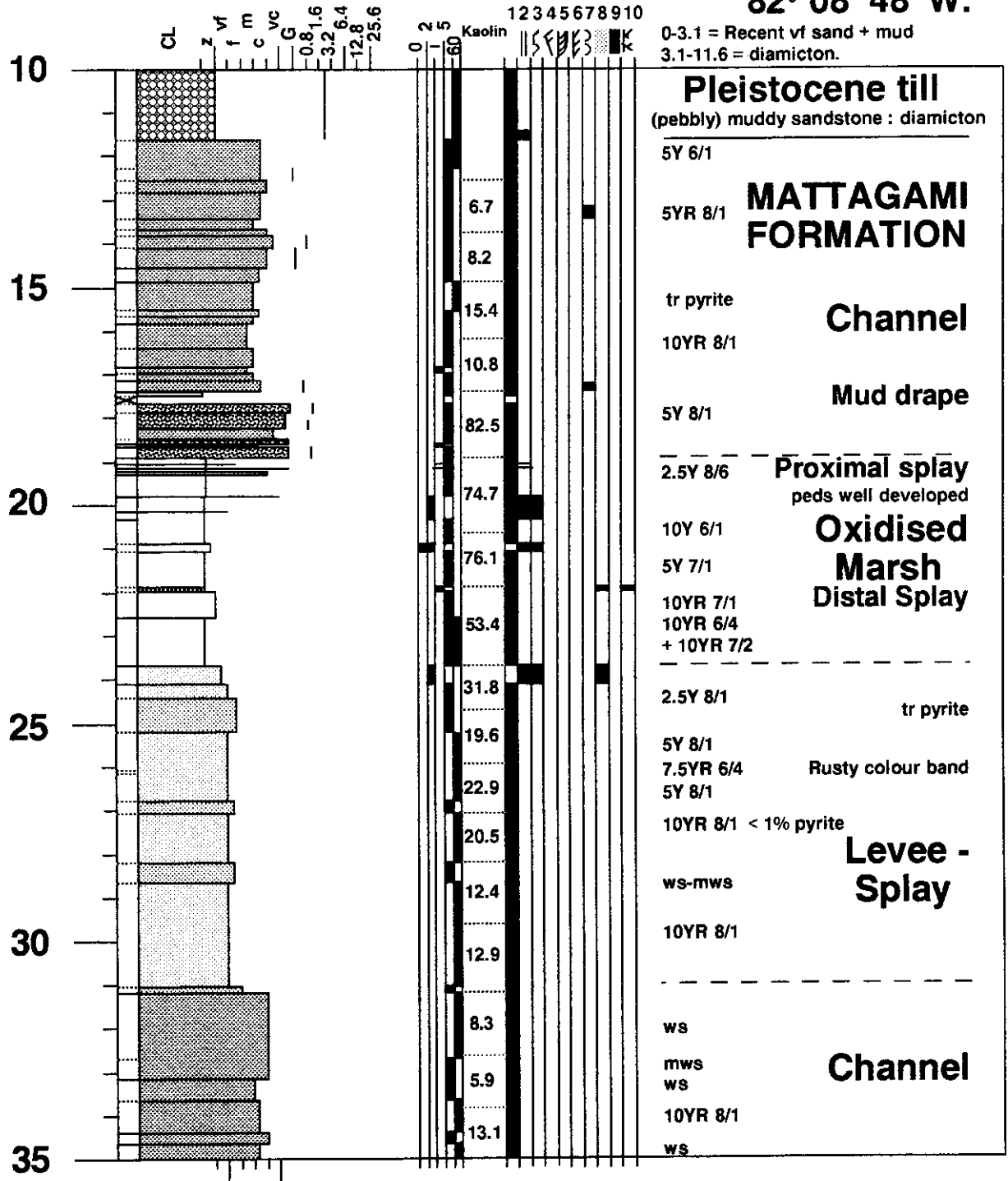
MRC hole 92-13, Kipling Twp.

50° 08'57"N,
82° 08'55"W.



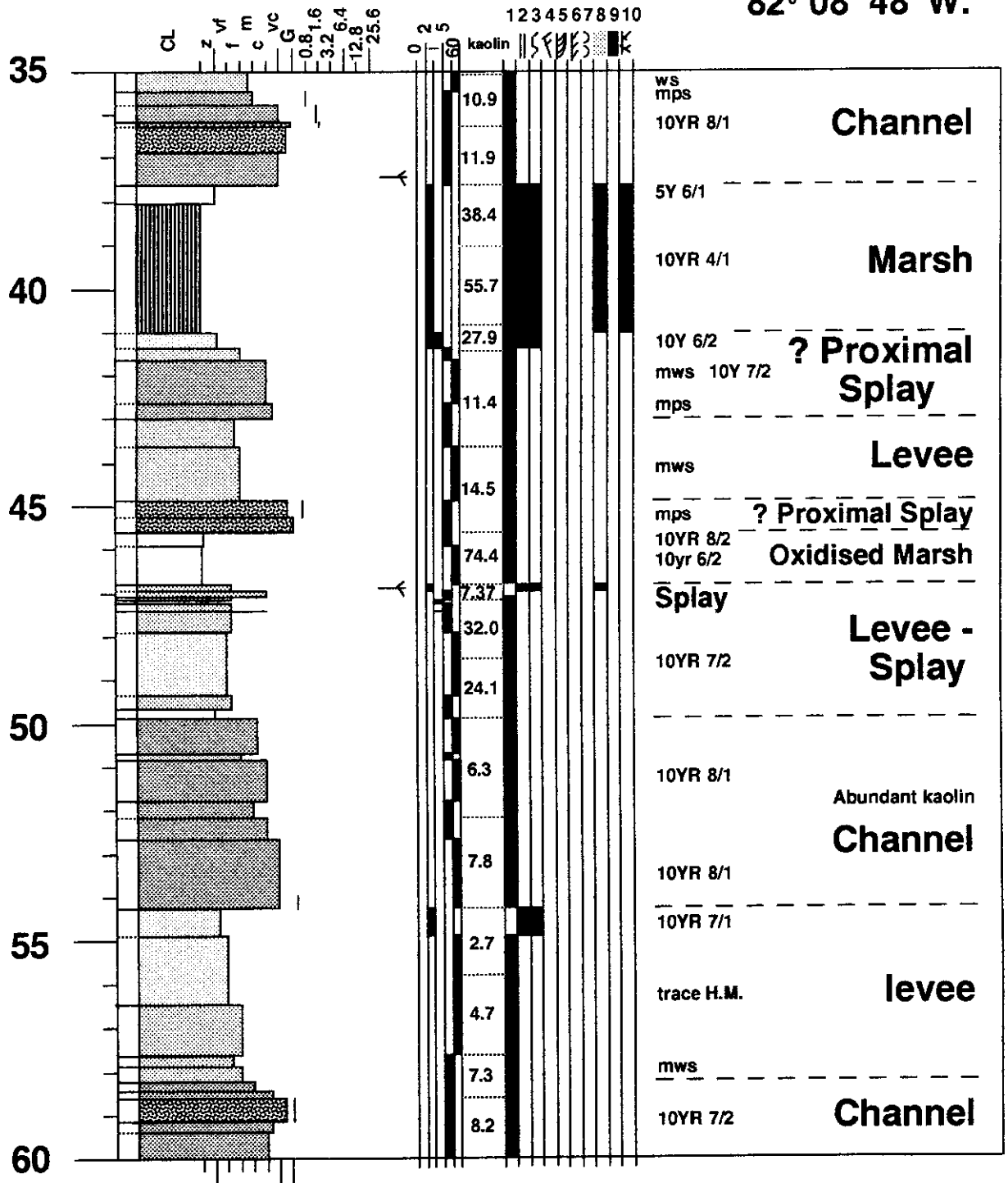
MRC hole 92-14, Kipling Twp.

50° 09' 00"N,
82° 08' 48"W.



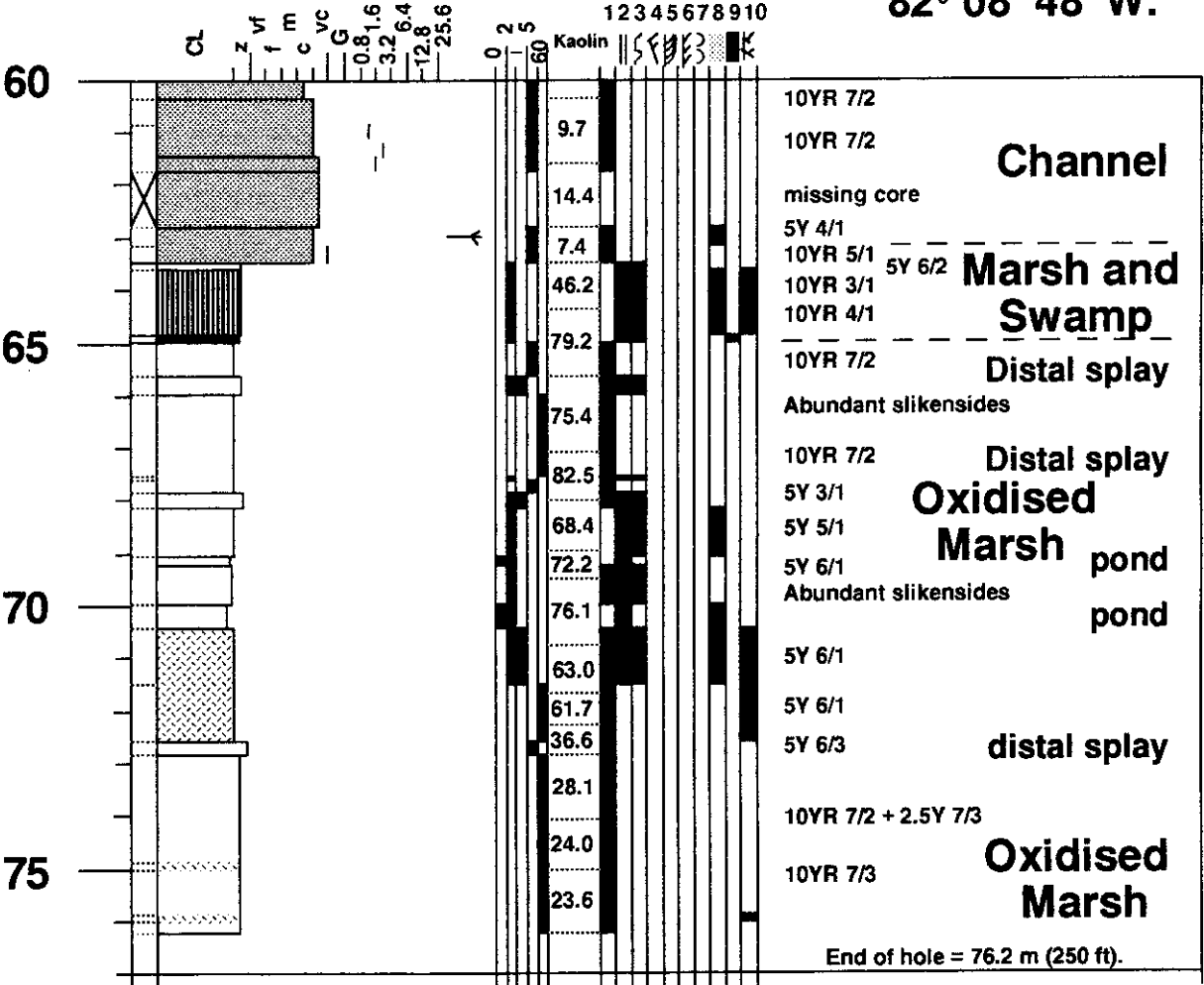
MRC hole 92-14, Kipling Twp.

50° 09' 00"N,
82° 08' 48"W.



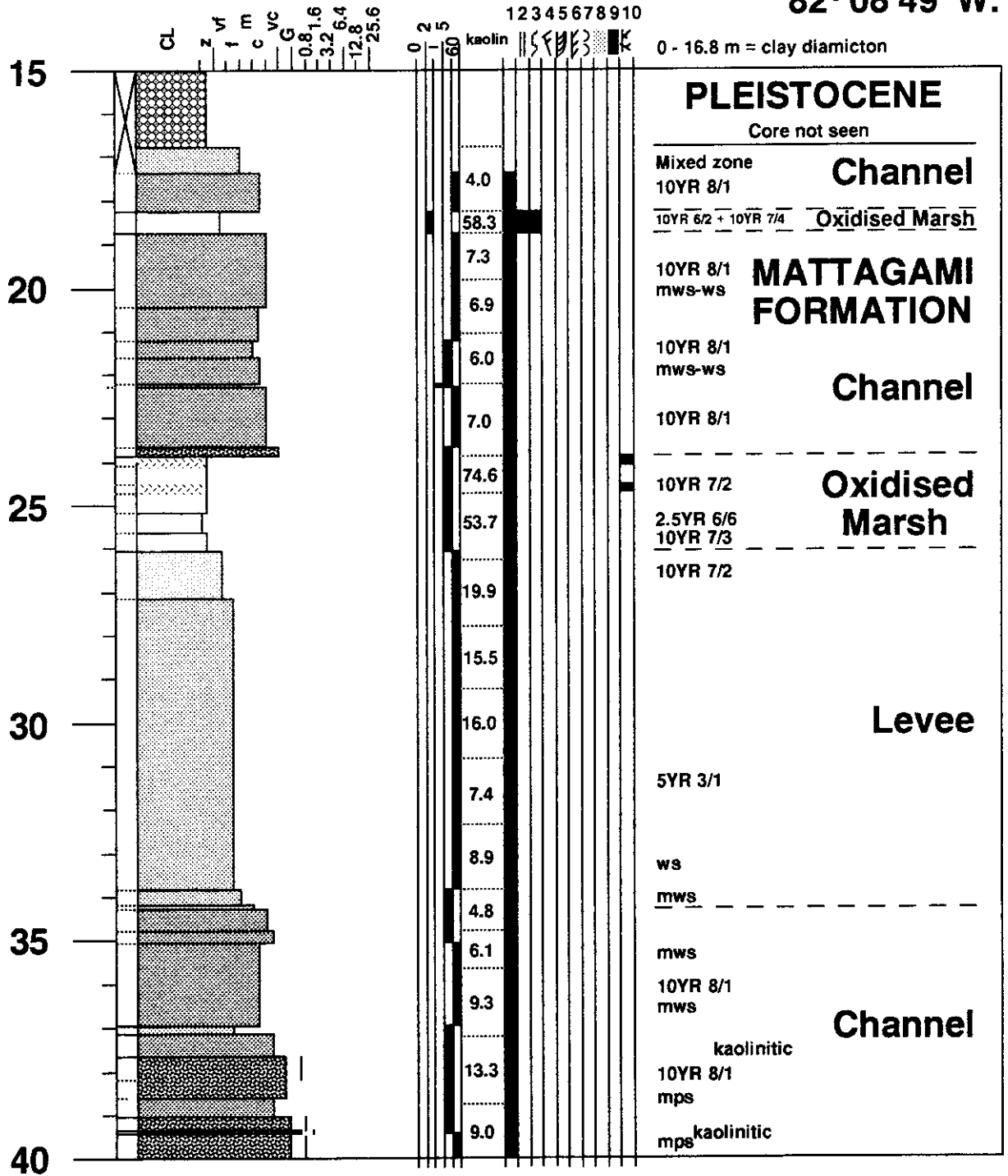
MRC hole 92-14, Kipling Twp.

50° 09' 00"N,
82° 08' 48"W.



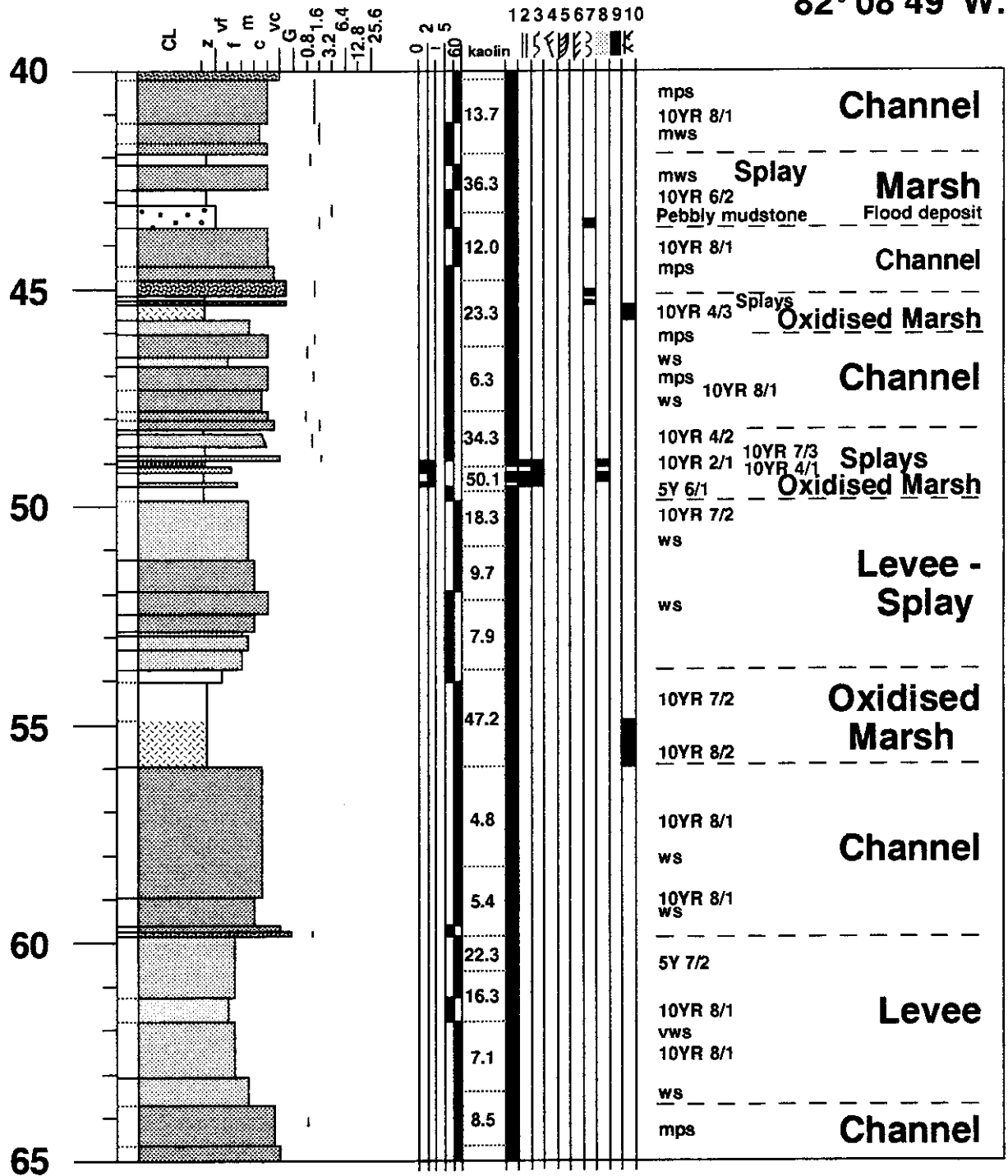
MRC hole 92-15, Kipling Twp.

50° 08'59"N,
82° 08'49"W.



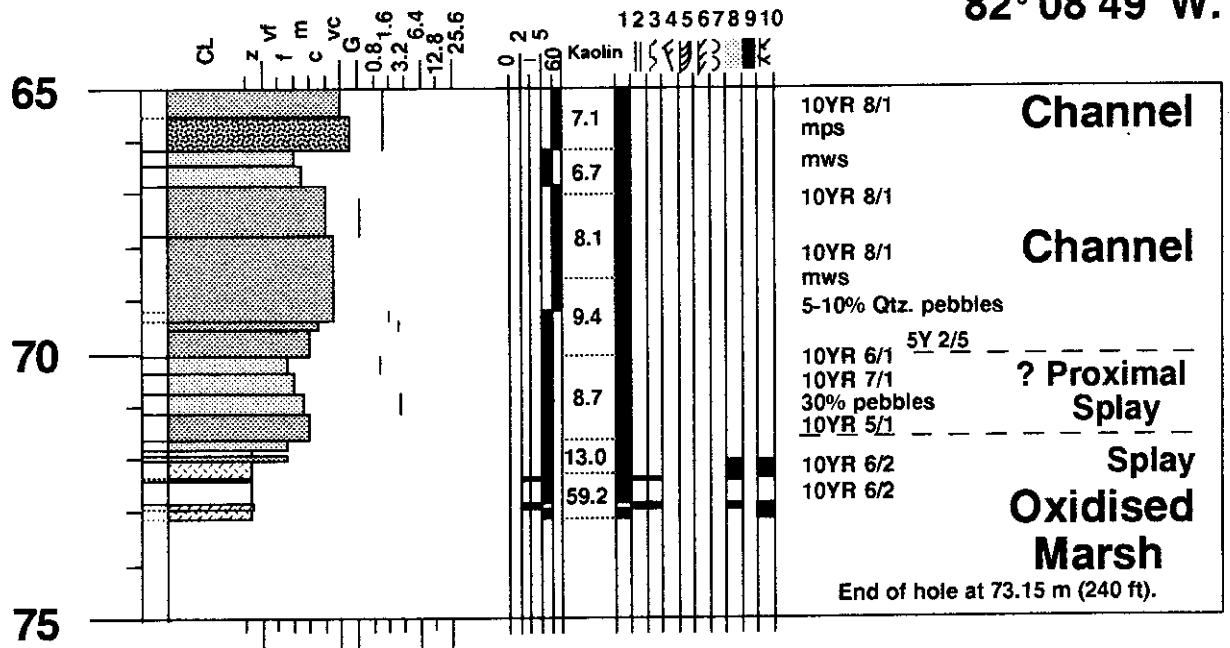
MRC hole 92-15, Kipling Twp

50° 08'59"N,
82° 08'49"W.



MRC hole 92-15, Kipling Twp.

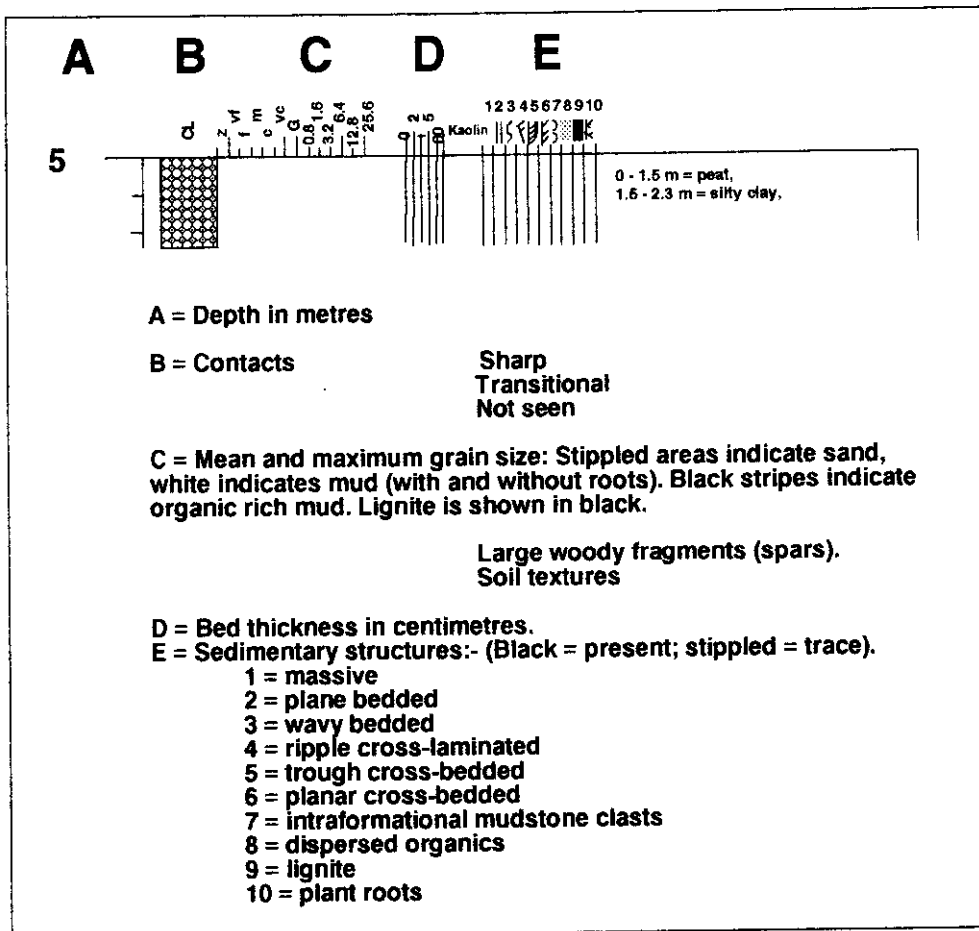
50° 08'59"N,
82° 08'49"W.



APPENDIX 2

Graphic logs based on re-interpretation of original logs by Anne Casselman,
Mineral Resources Canada.

Legend:-



ab = abundant; tr = trace; H.M. = heavy minerals; Dk = dark;

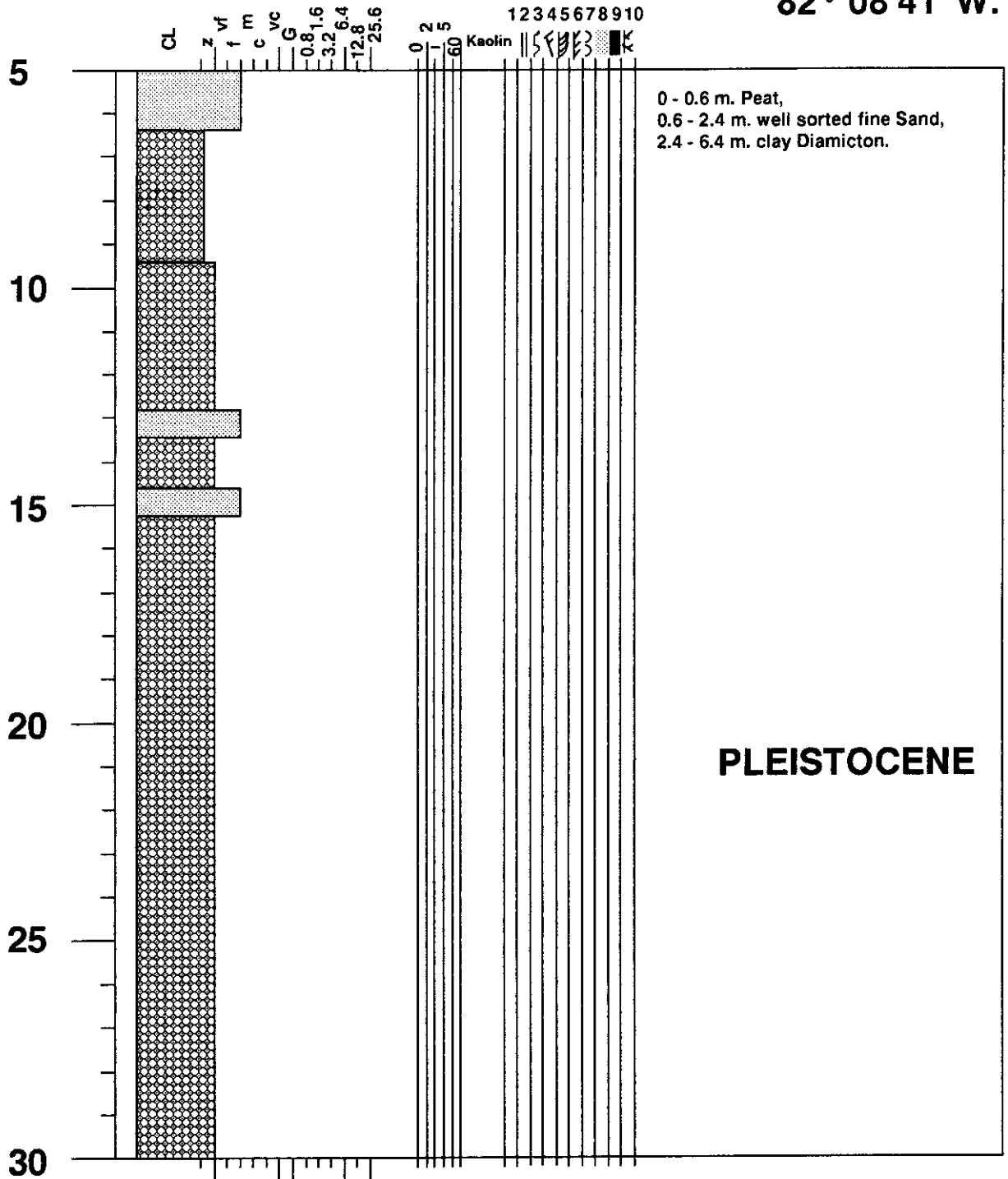
Md = medium; Lt = light.

B = brown; Y = yellow; W = white; Gy = grey; Blk = black; R = red;

Gn = green.

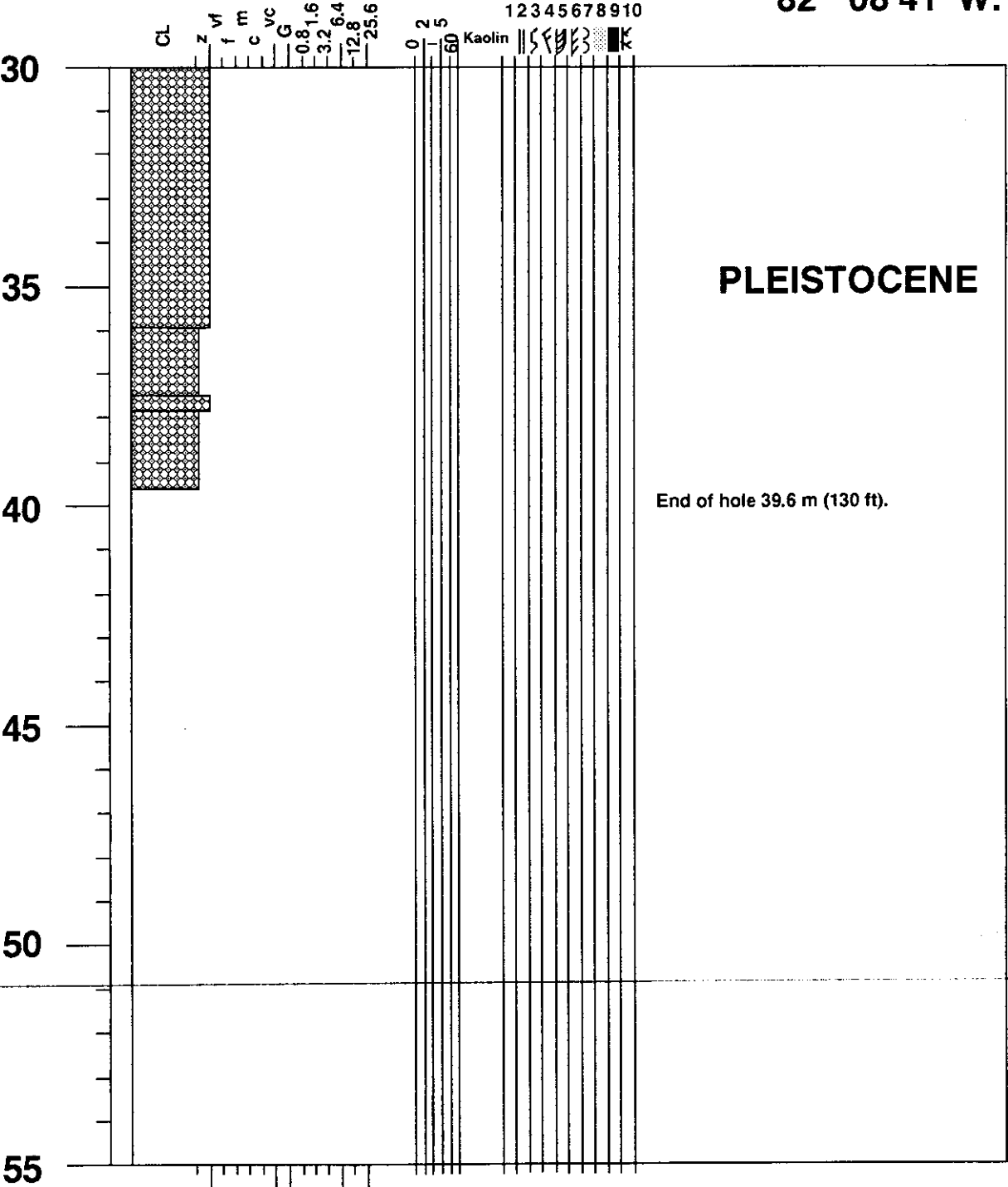
MRC hole 88 - 2, Kipling Twp.

50° 08'44"N,
82° 08'41"W.



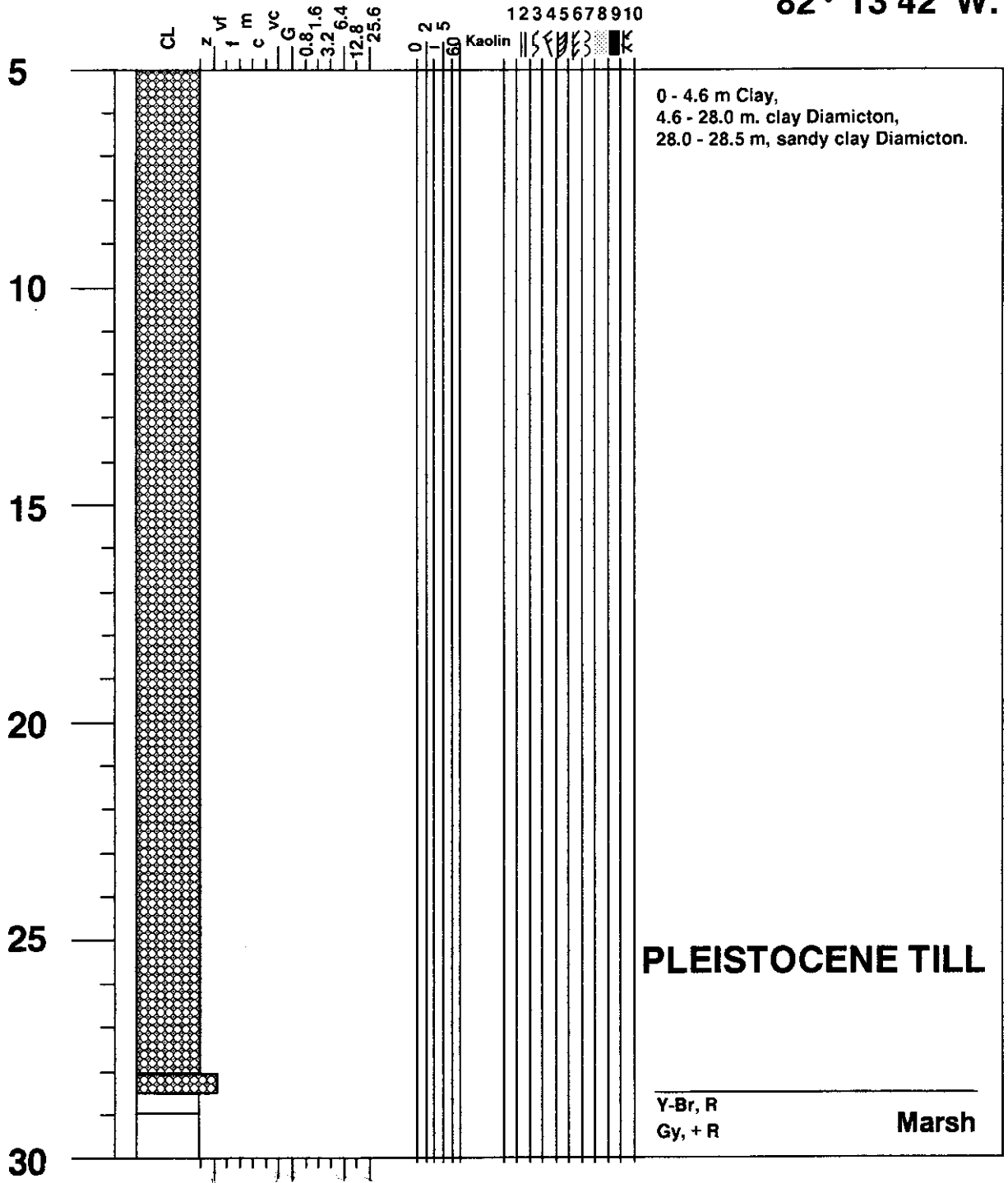
MRC hole 88 - 2, Kipling Twp.

50° 08'44"N,
82° 08'41"W.



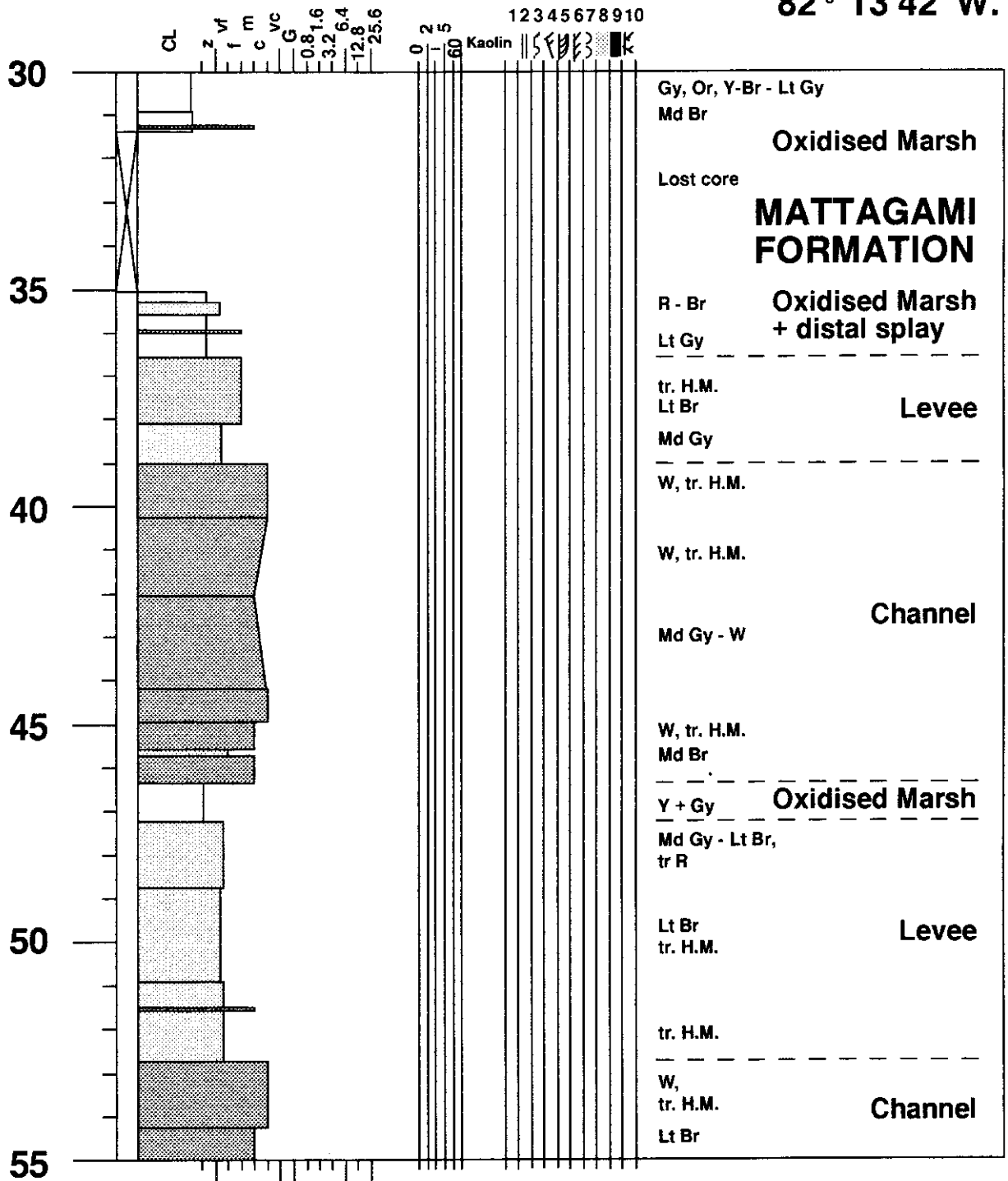
MRC hole 88 - 3, Kipling Twp.

50° 08'57"N,
82° 13'42"W.



MRC hole 88 - 3, Kipling Twp.

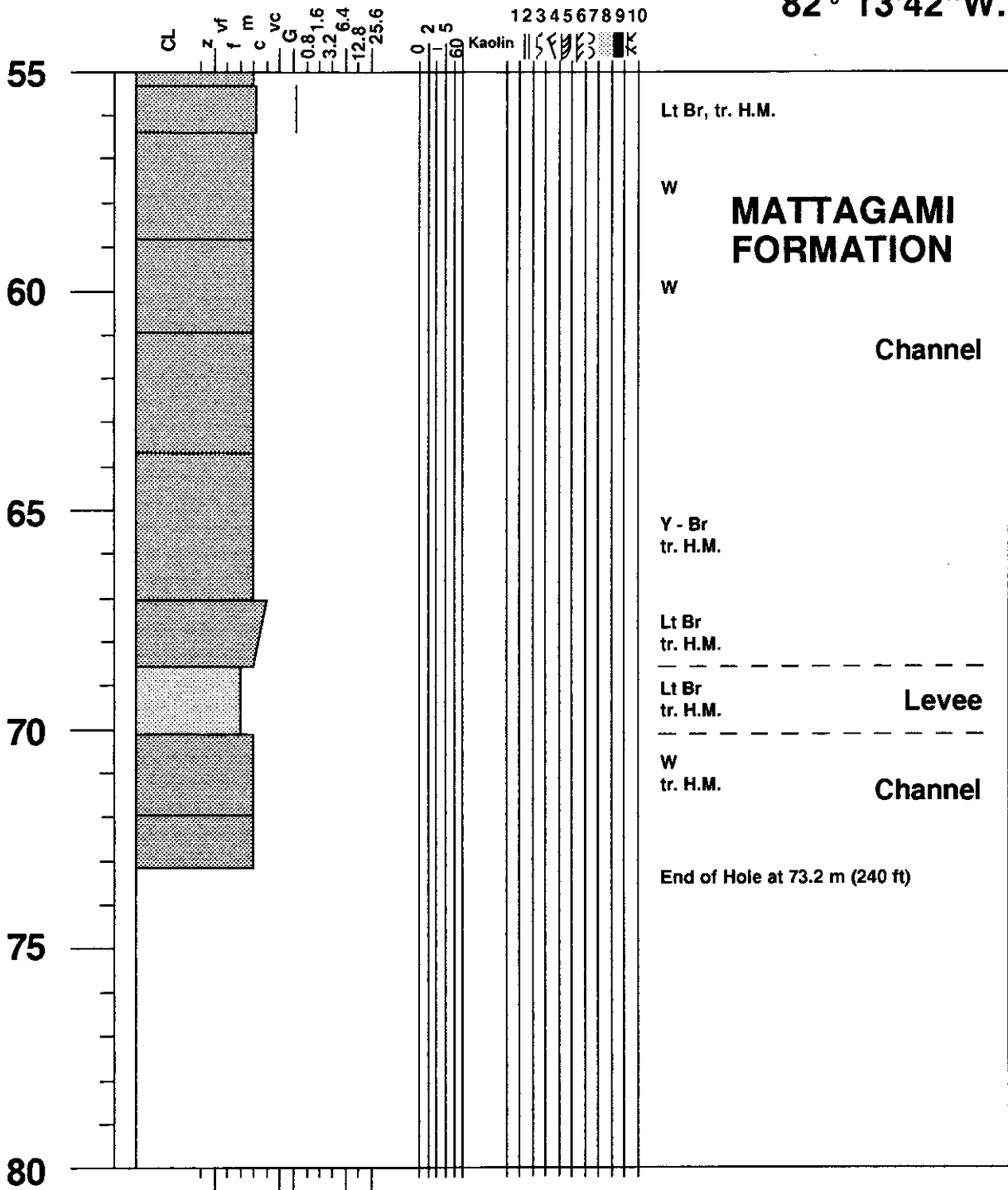
50° 08'57"N,
82° 13'42"W.



124b

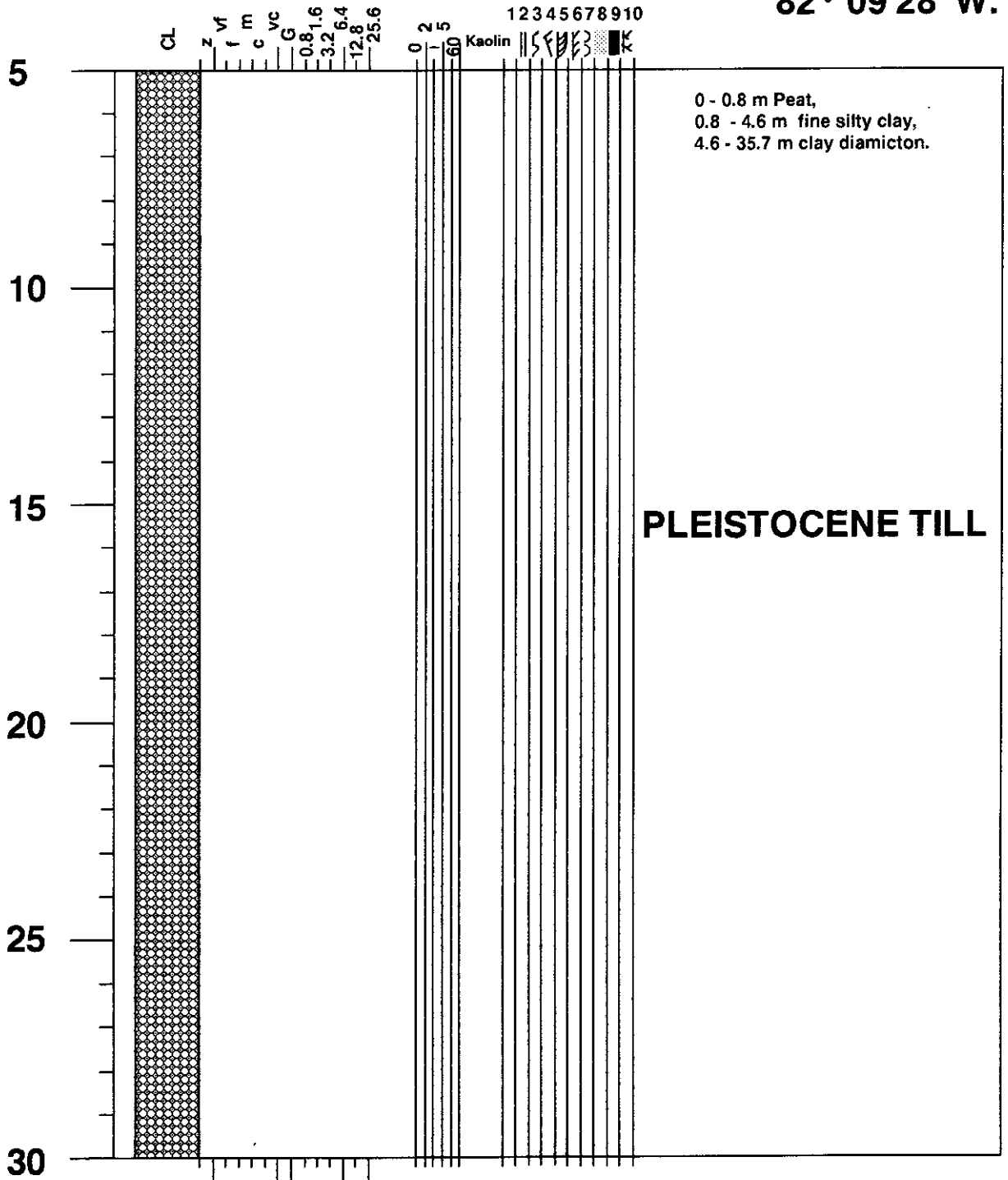
MRC hole 88 - 3, Kipling Twp.

50° 08'57"N,
82° 13'42"W.



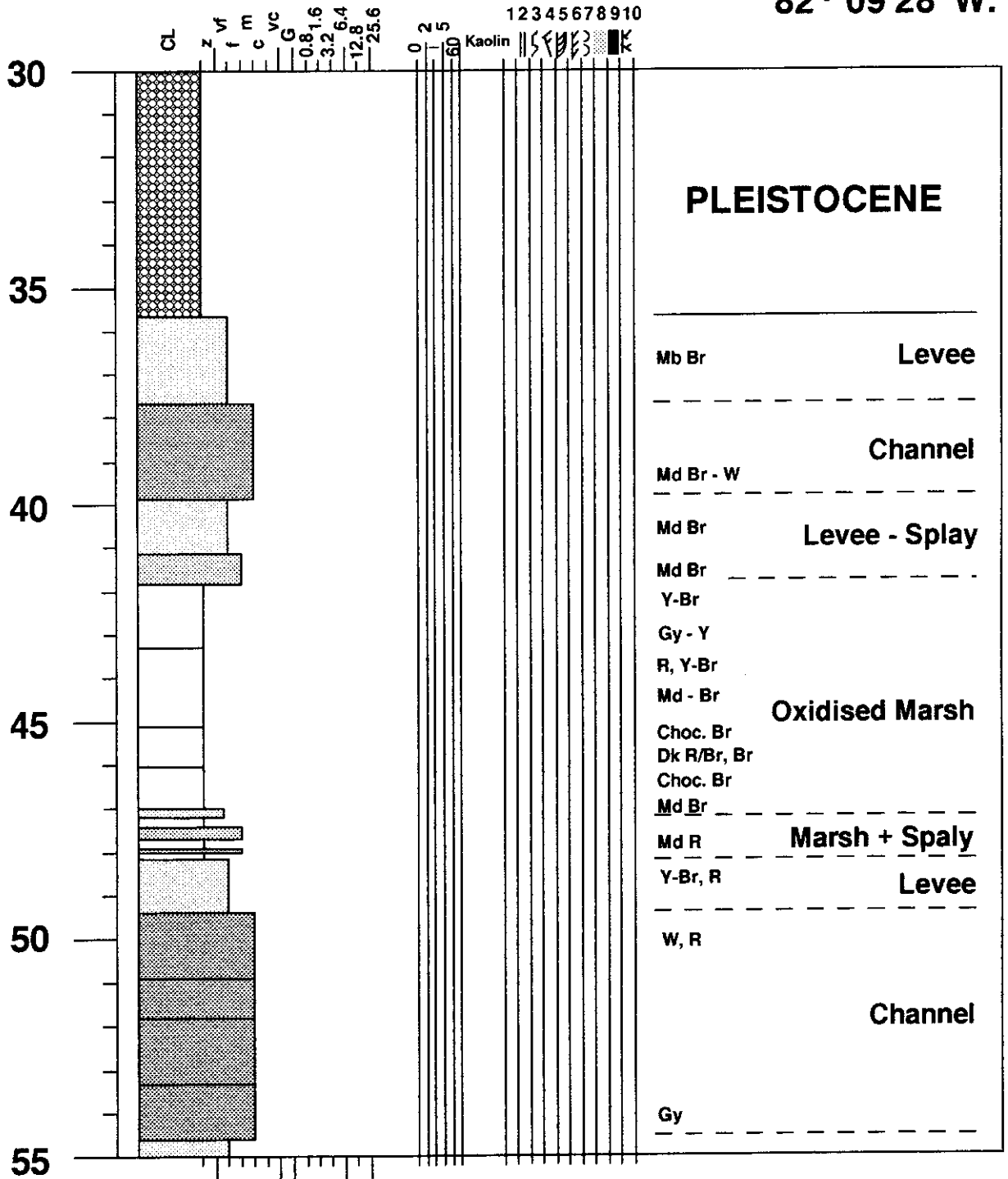
MRC hole 89 - 1, Kipling Twp.

50° 08'42"N,
82° 09'28"W.



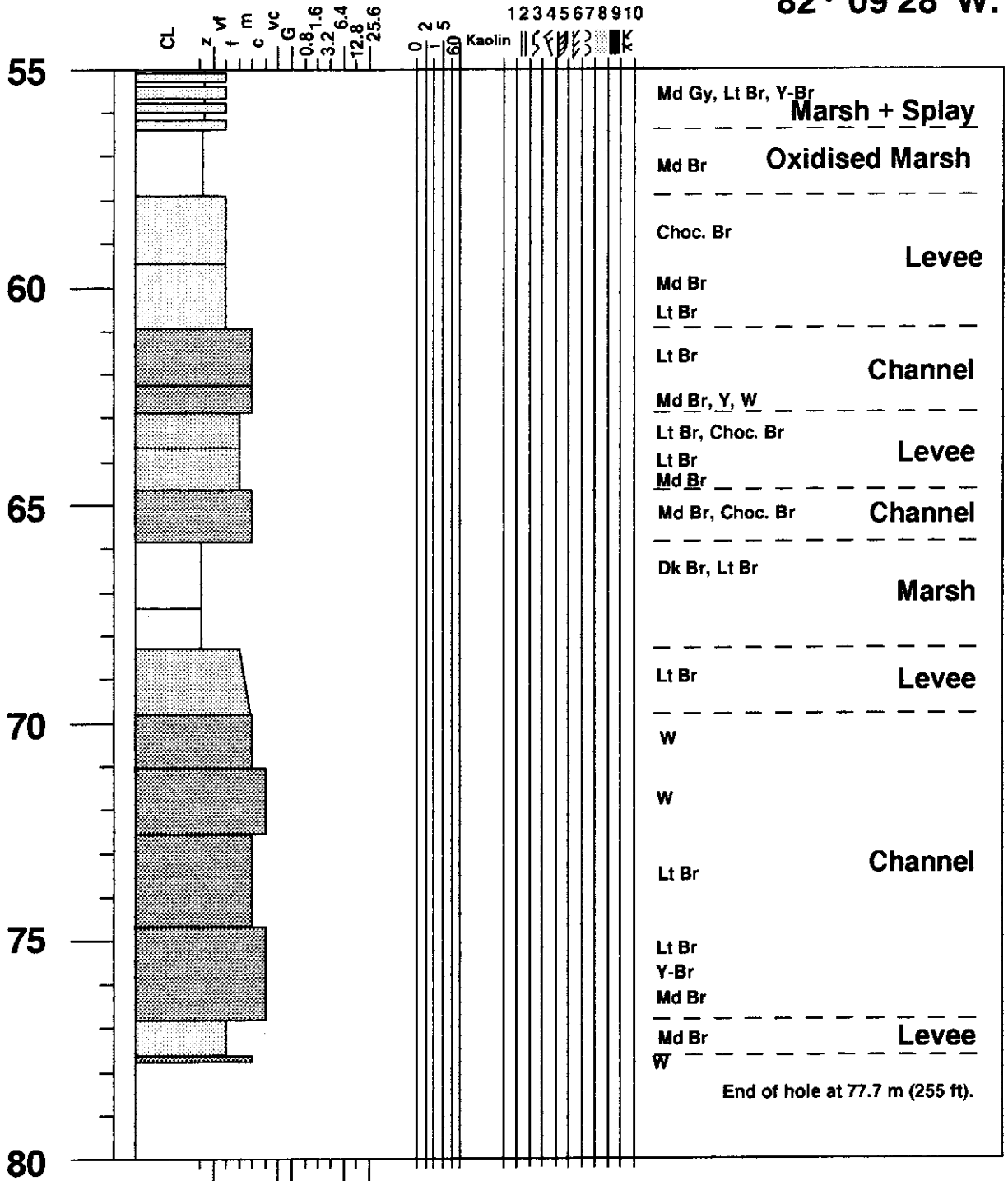
MRC hole 89 - 1, Kipling Twp.

50° 08'42"N,
82° 09'28"W.



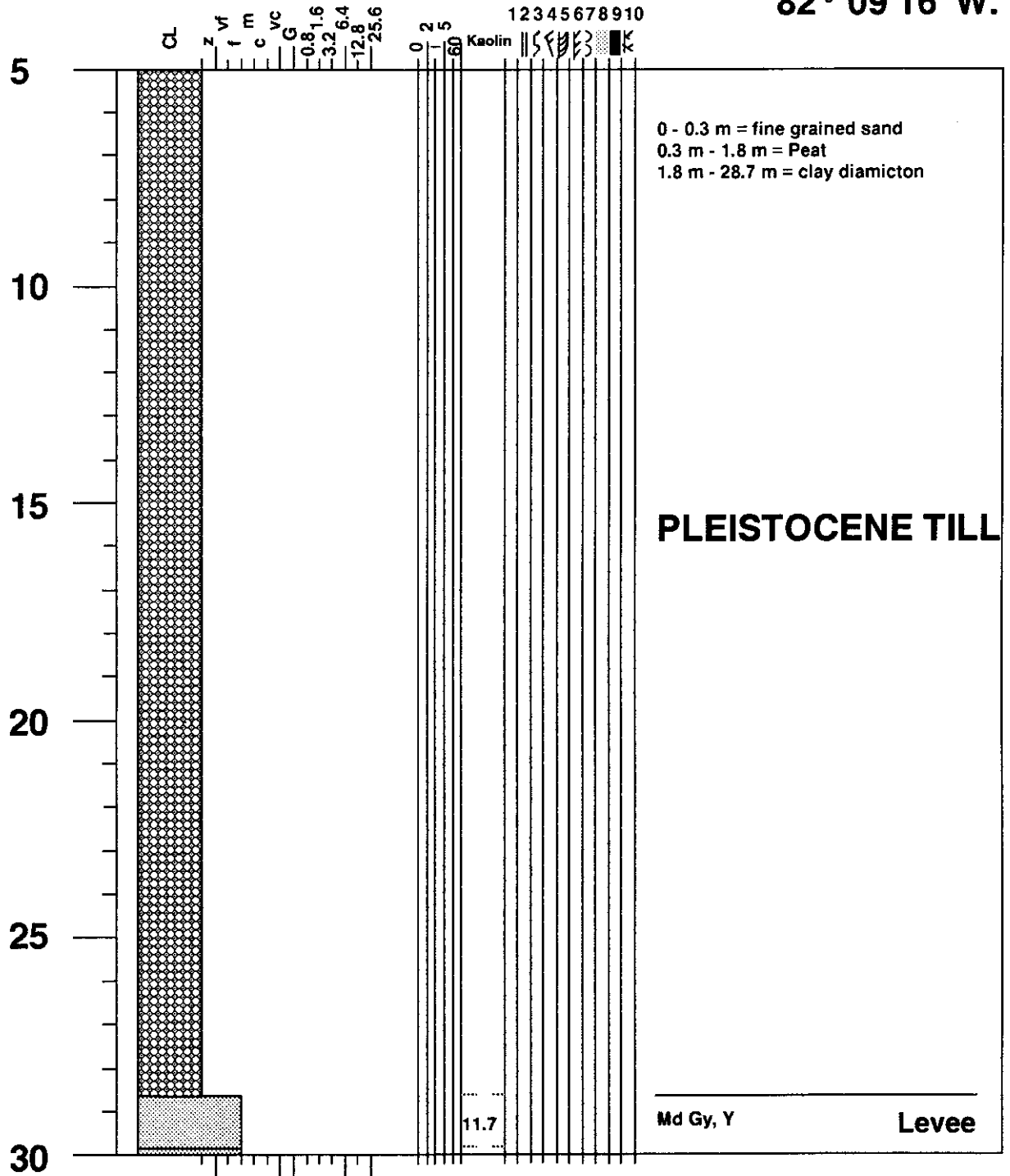
MRC hole 89 - 1, Kipling Twp.

50° 08'42"N,
82° 09'28"W.



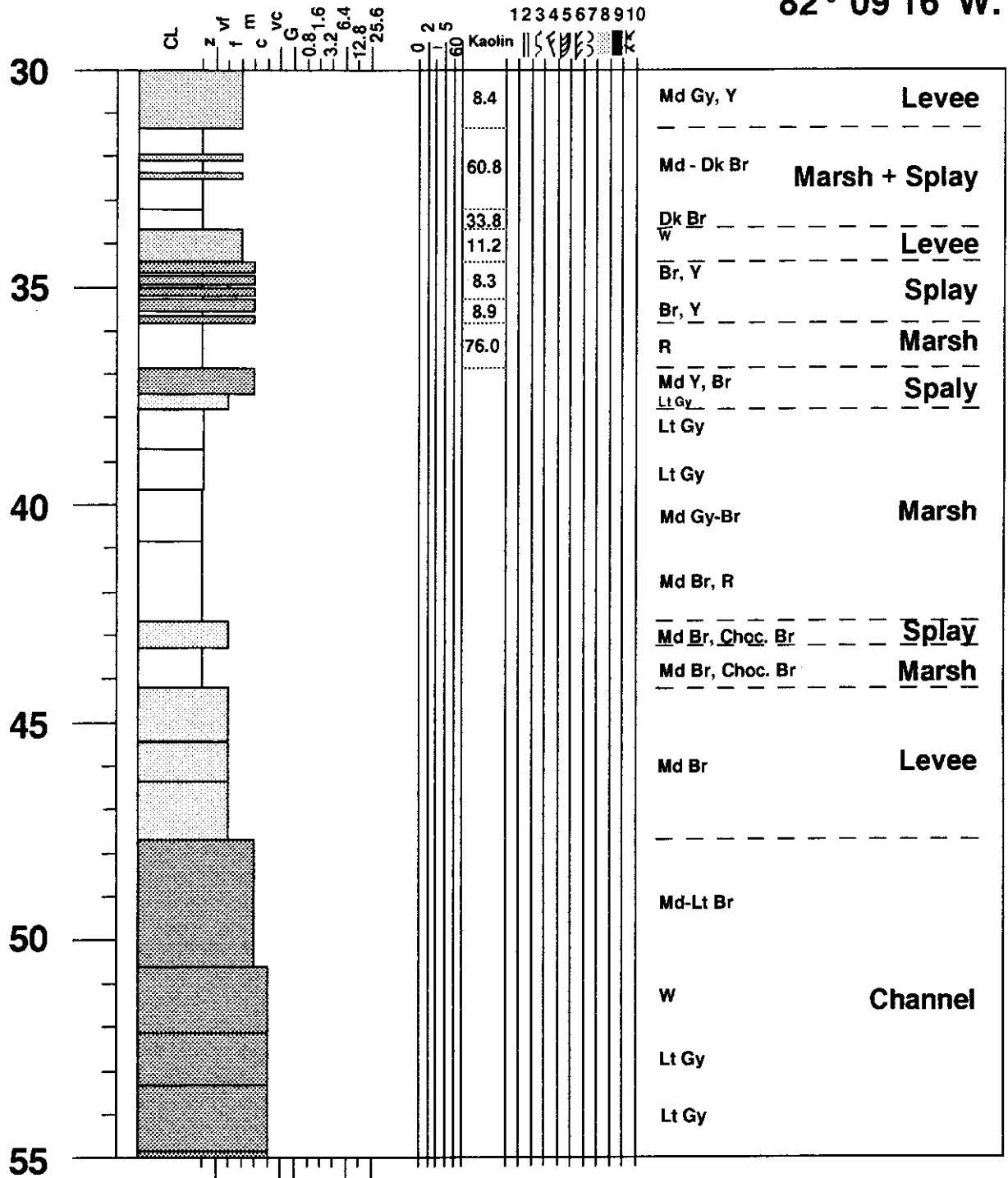
MRC hole 89 - 2, Kipling Twp.

50° 09'01"N,
82° 09'16"W.



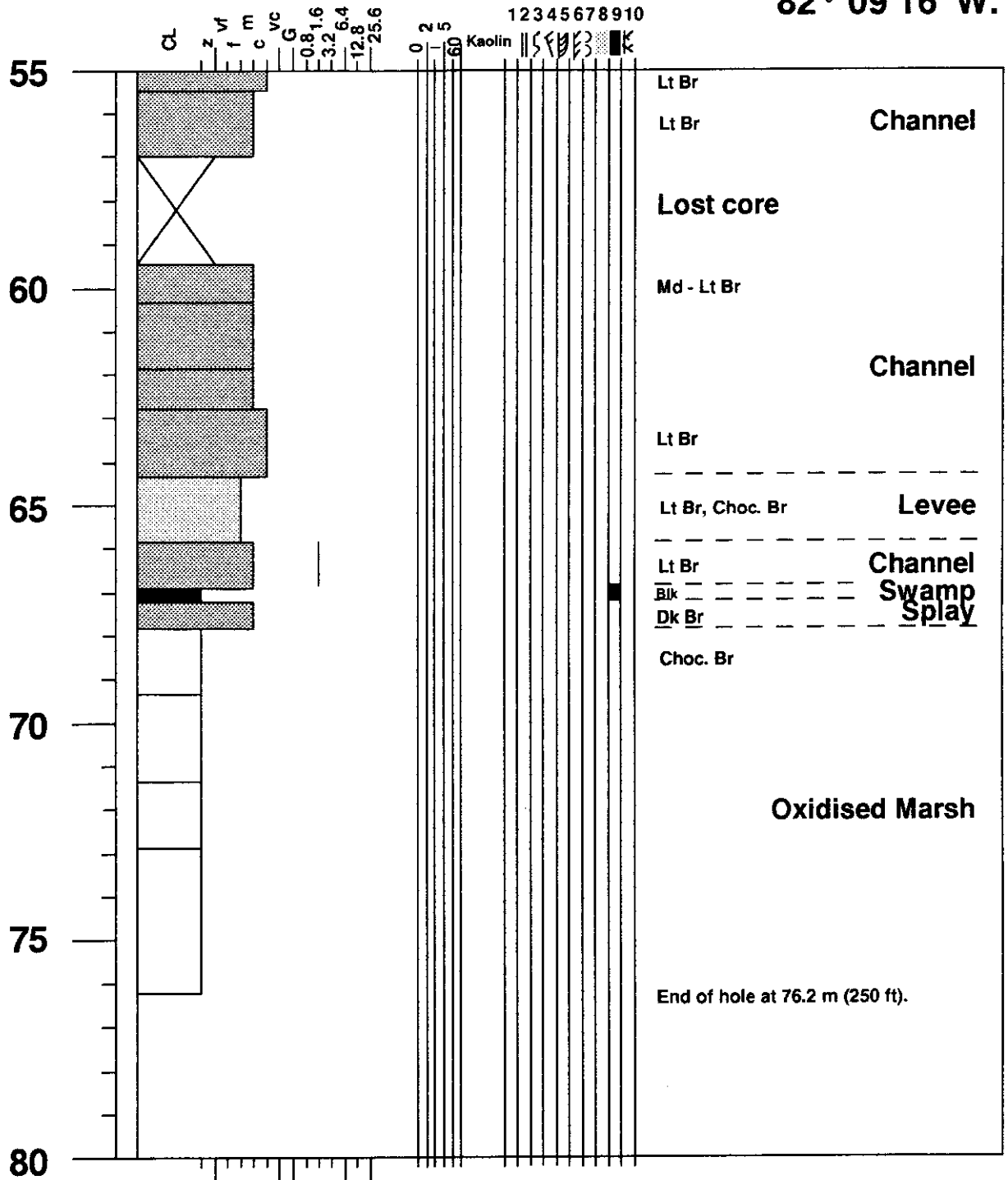
MRC hole 89 - 2, Kipling Twp.

50° 09'01"N,
82° 09'16"W.



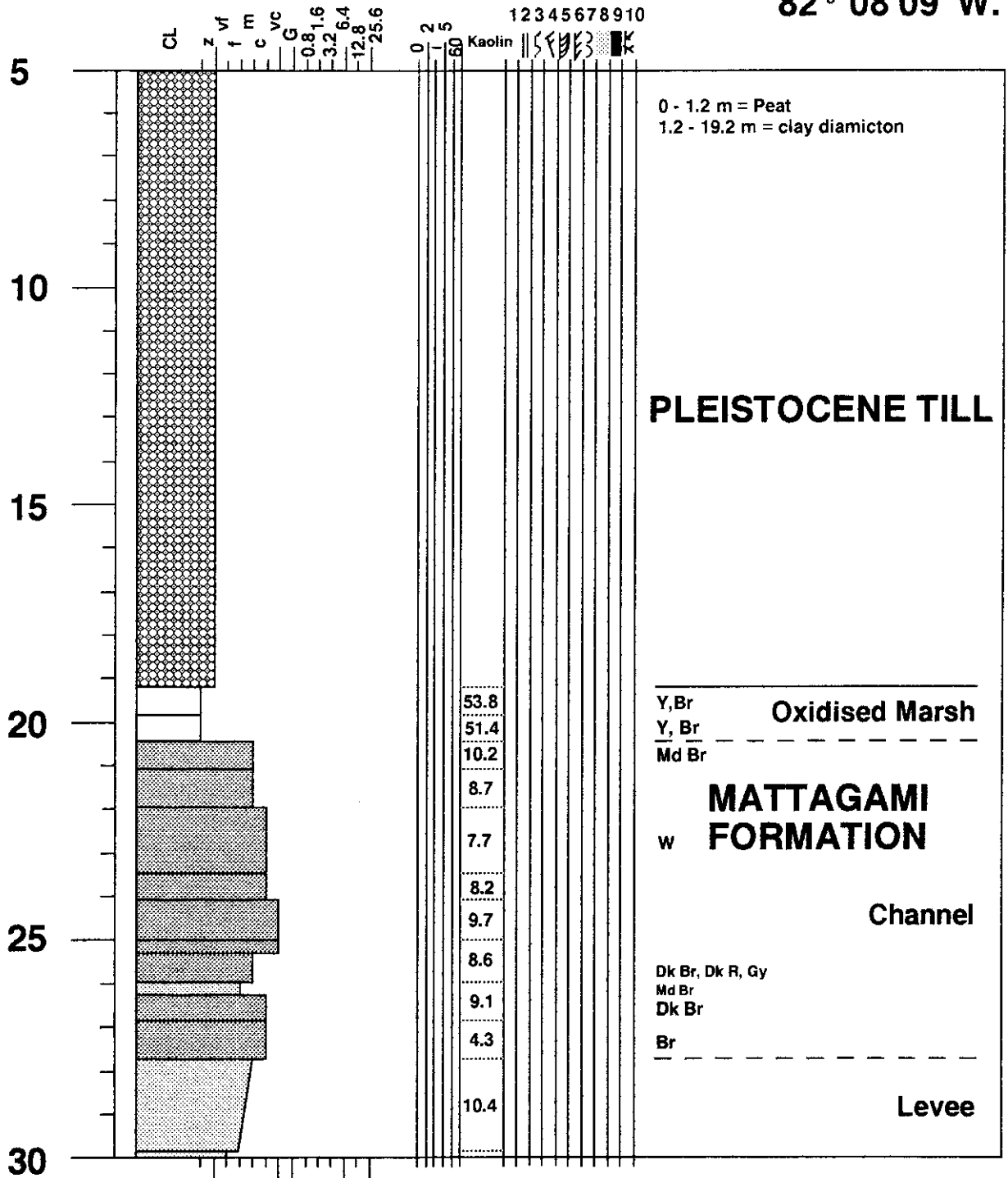
MRC hole 89 - 2, Kipling Twp.

50° 09'01"N,
82° 09'16"W.



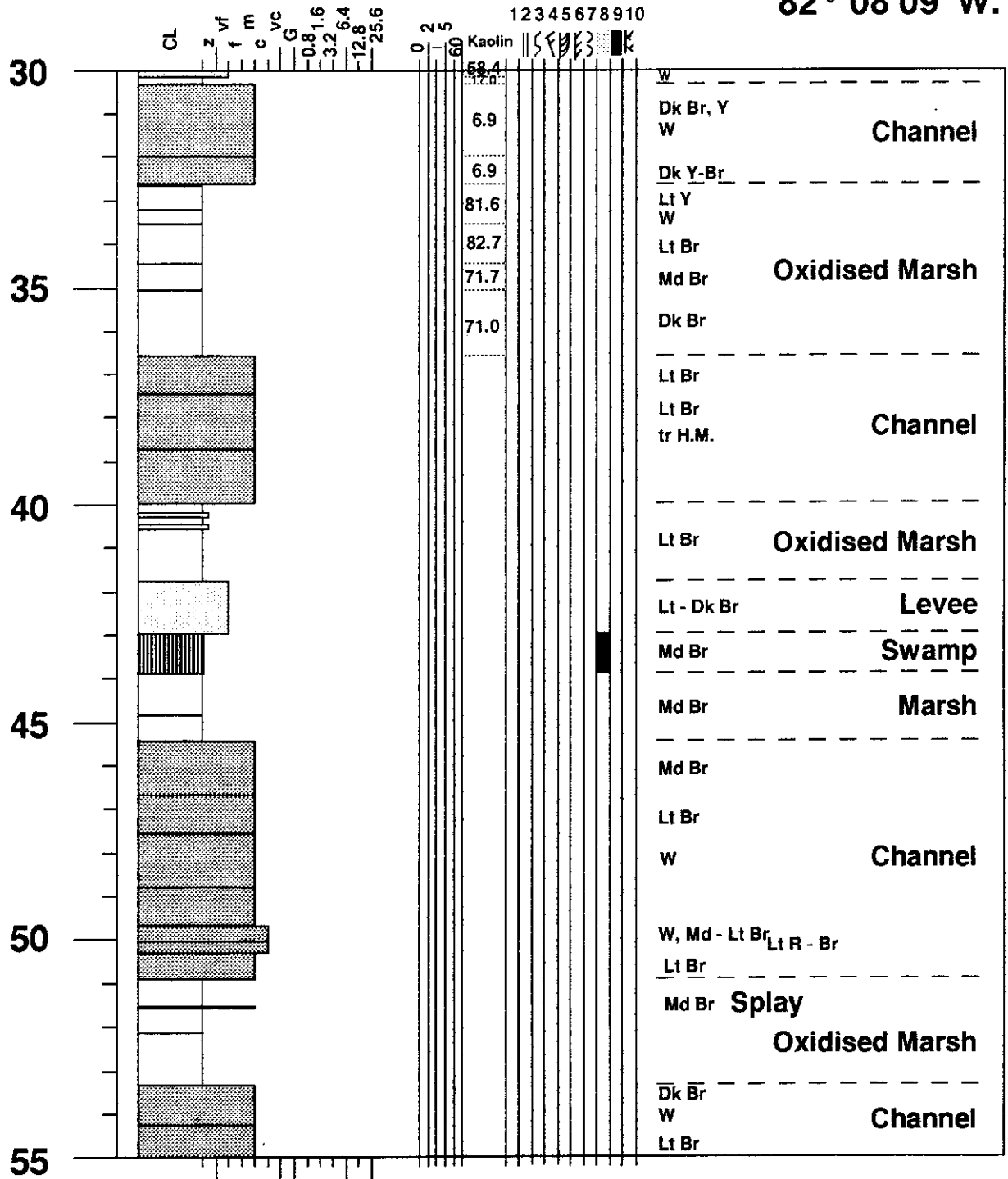
MRC hole 89 - 3, Kipling Twp.

50° 09'01"N,
82° 08'09"W.



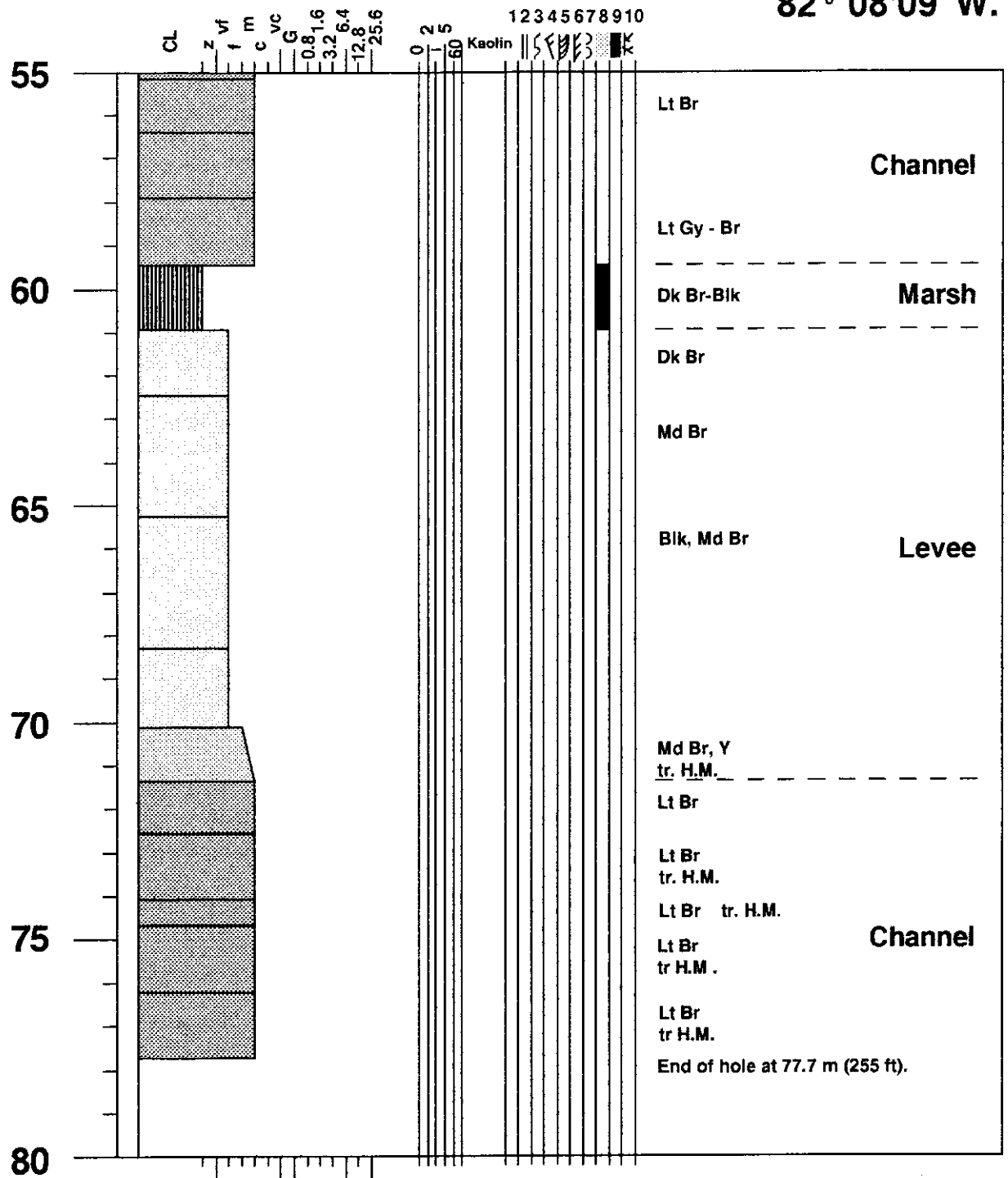
MRC hole 89 - 3, Kipling Twp.

50° 09'01"N,
82° 08'09"W.



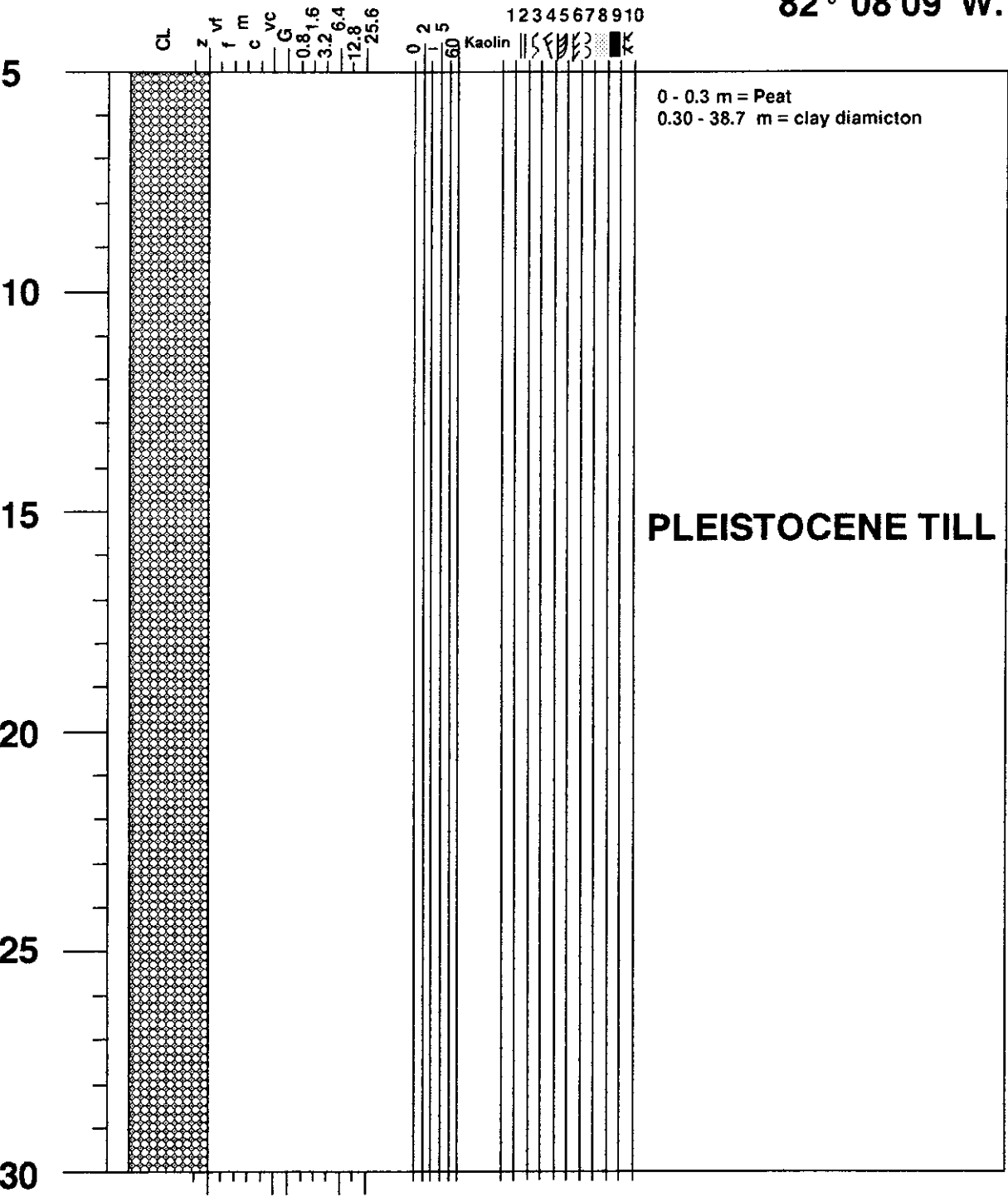
MRC hole 89 - 3, Kipling Twp.

50° 09'01"N,
82° 08'09"W.



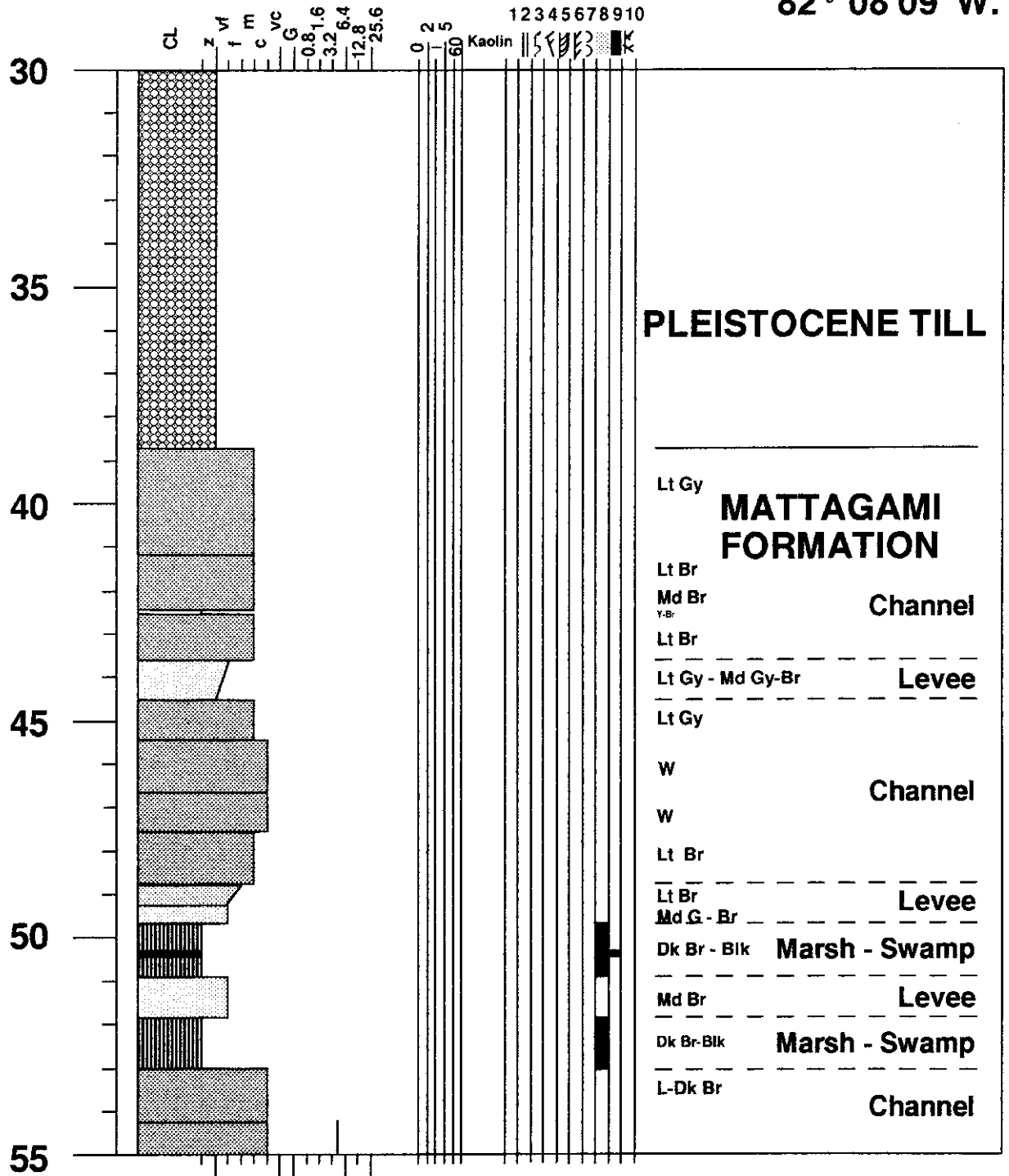
MRC hole 89 - 4, Kipling Twp.

50° 09'09"N,
82° 08'09"W.



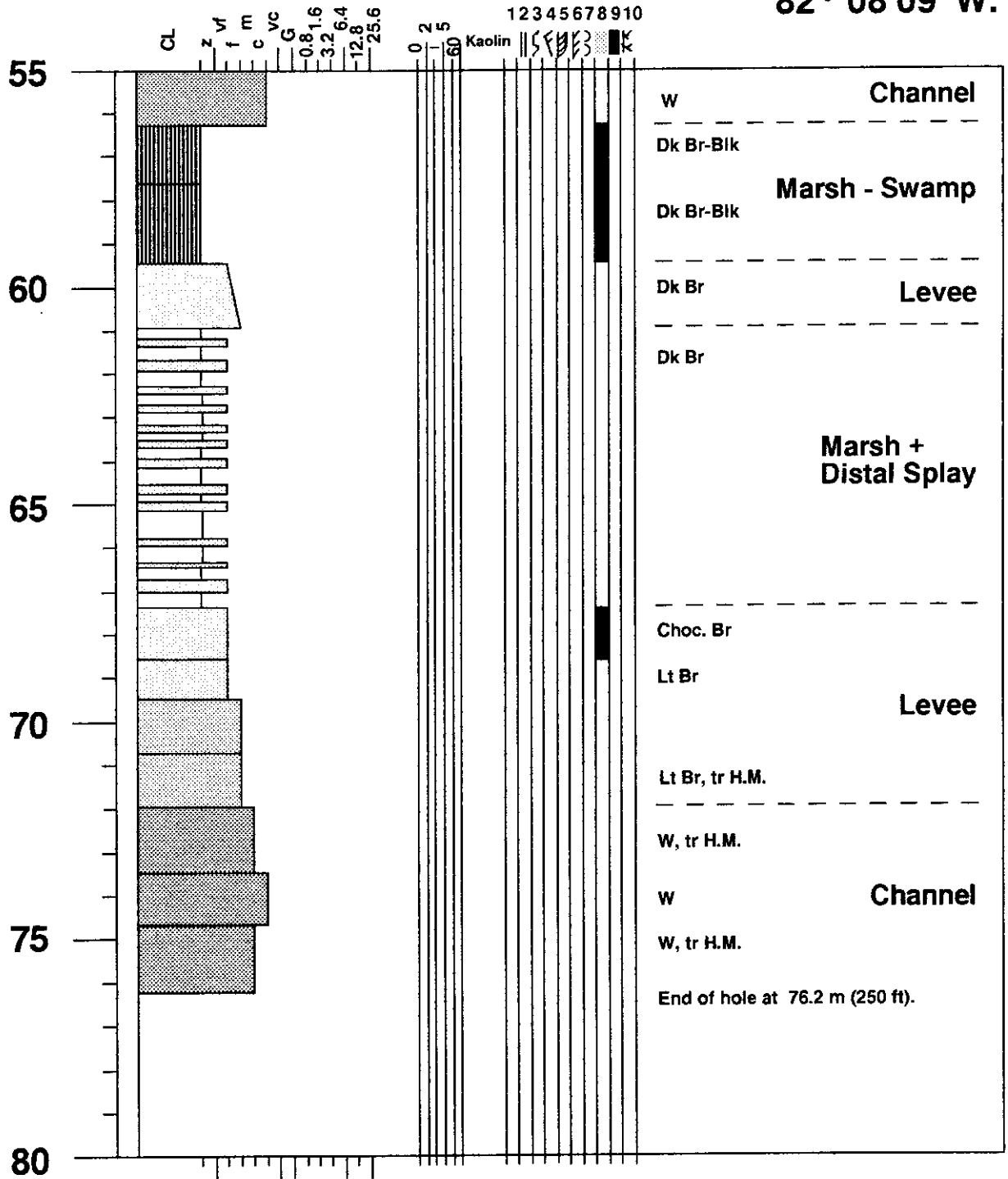
MRC hole 89 - 4, Kipling Twp.

50° 09'09"N,
82° 08'09"W.



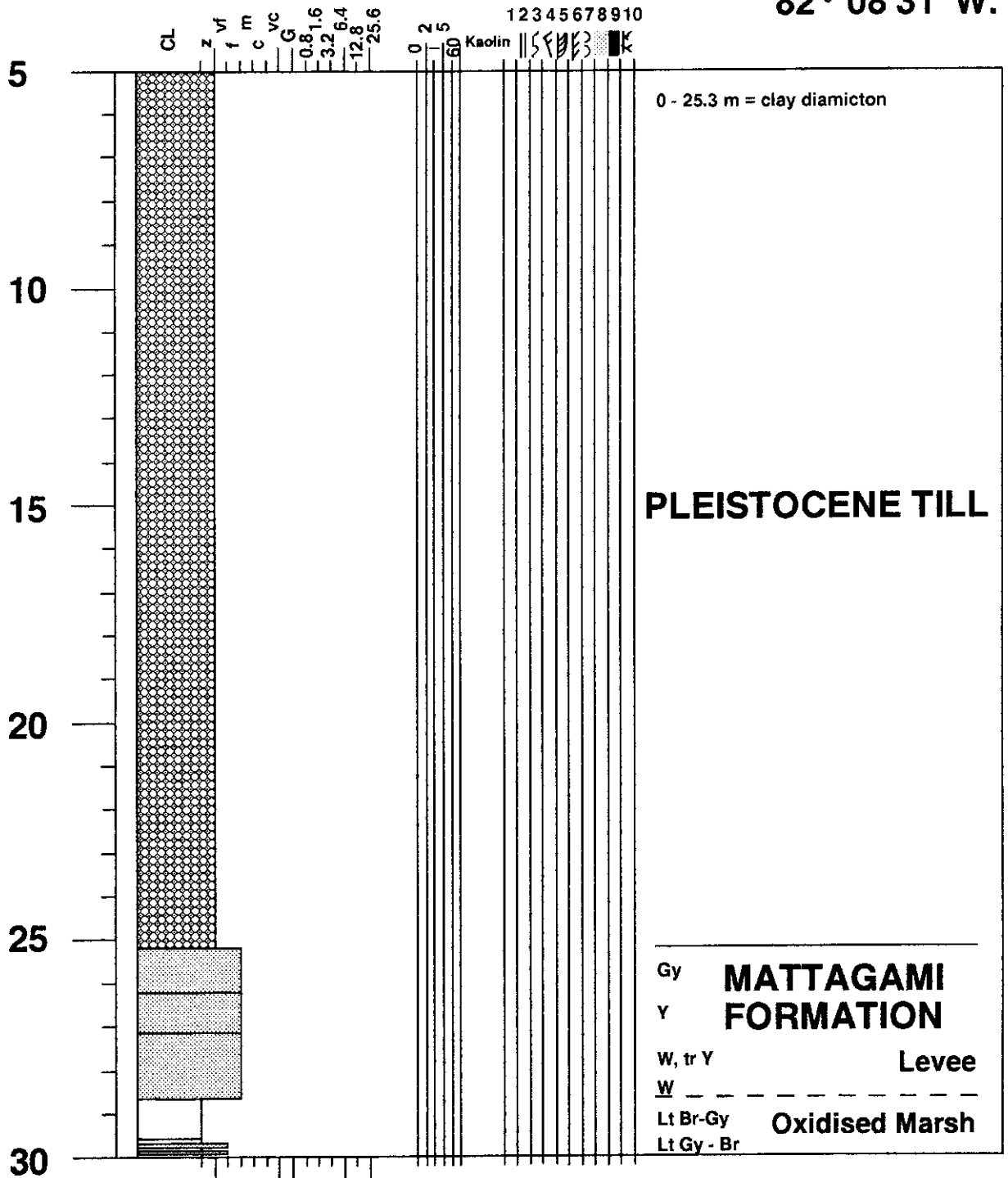
MRC hole 89 - 4, Kipling Twp.

50° 09'09"N,
82° 08'09"W.



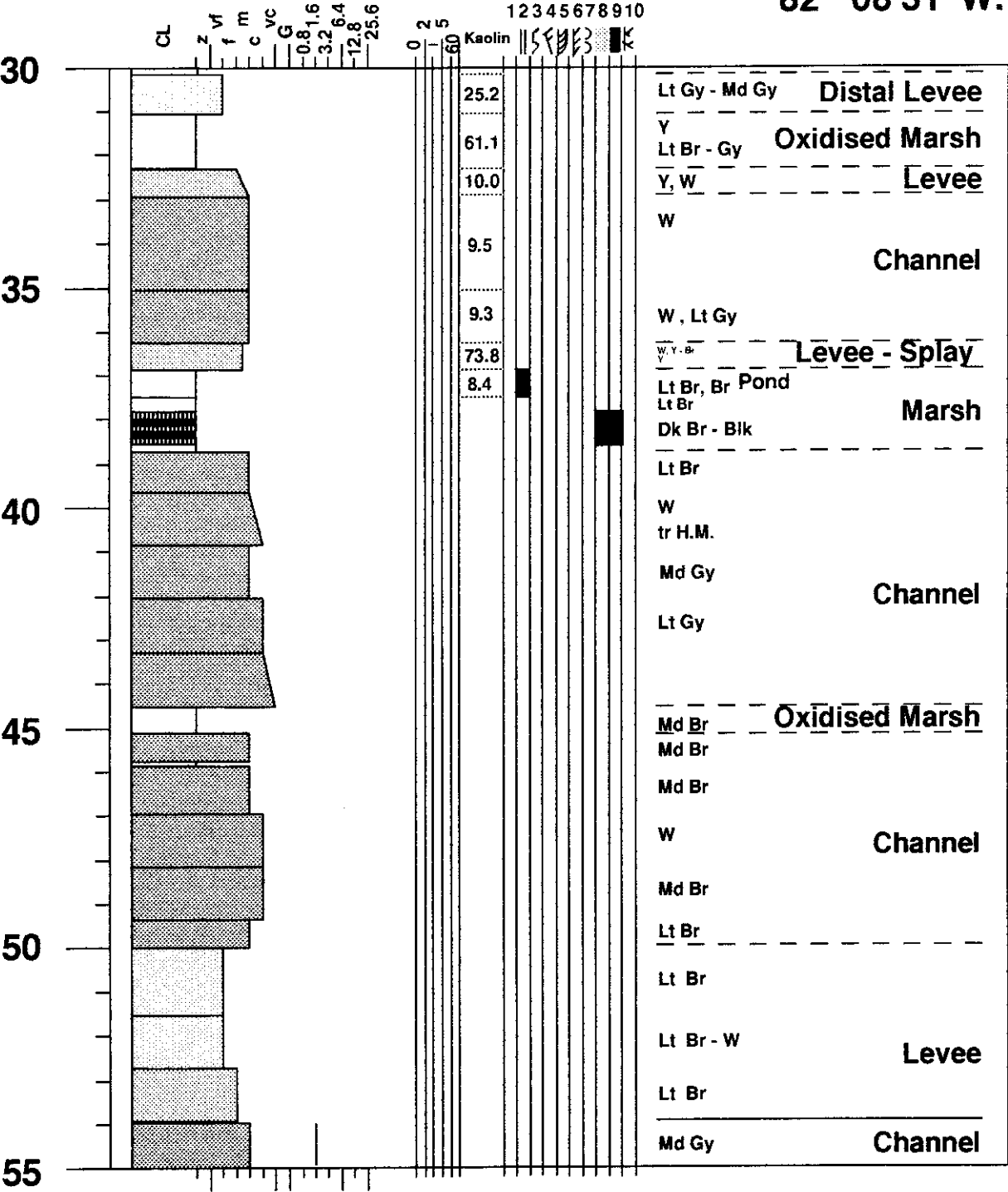
MRC hole 89 - 5, Kipling Twp.

50° 09'08"N,
82° 08'31"W.



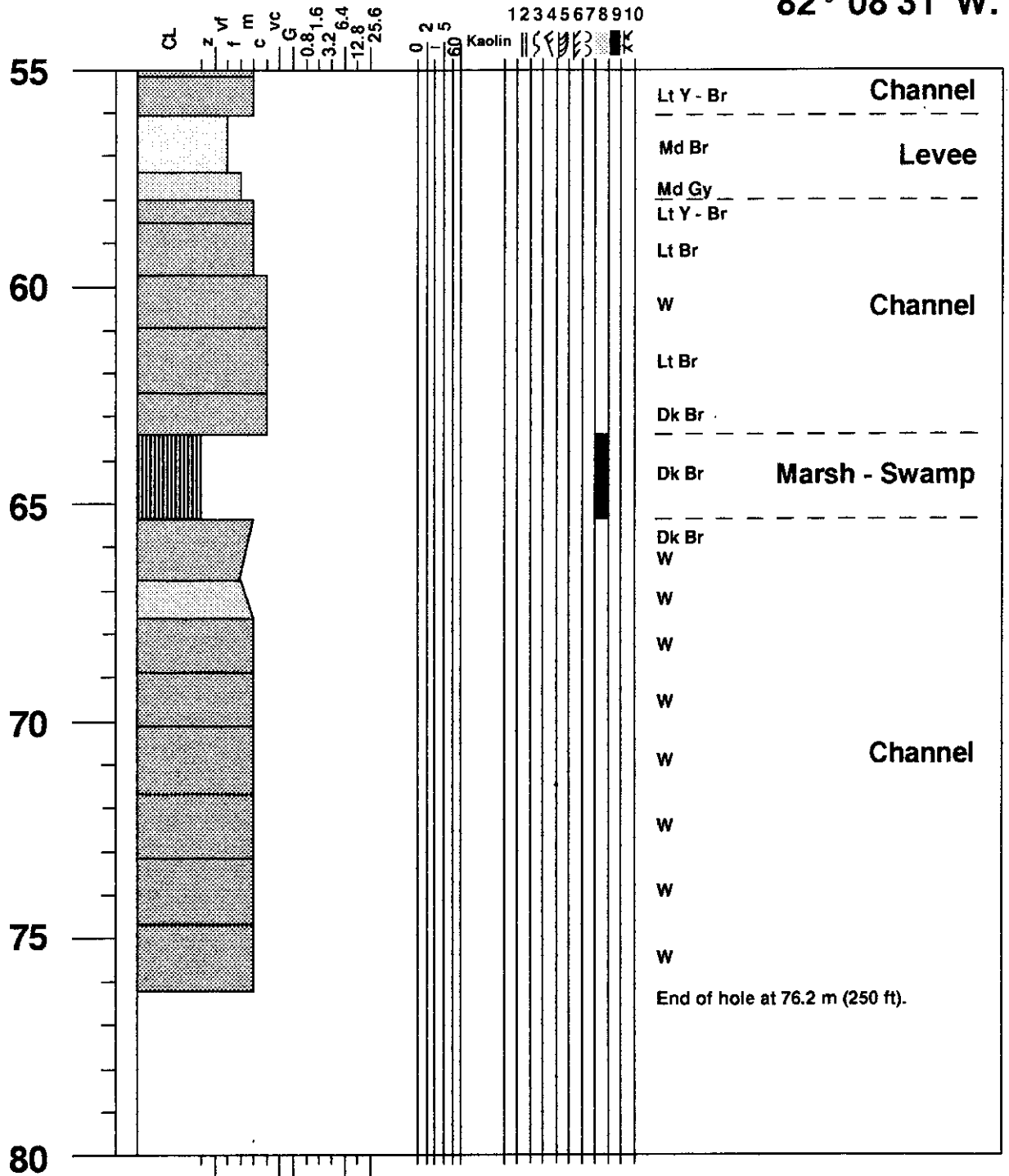
MRC hole 89 - 5, Kipling Twp.

50° 09'08"N,
82° 08'31"W.



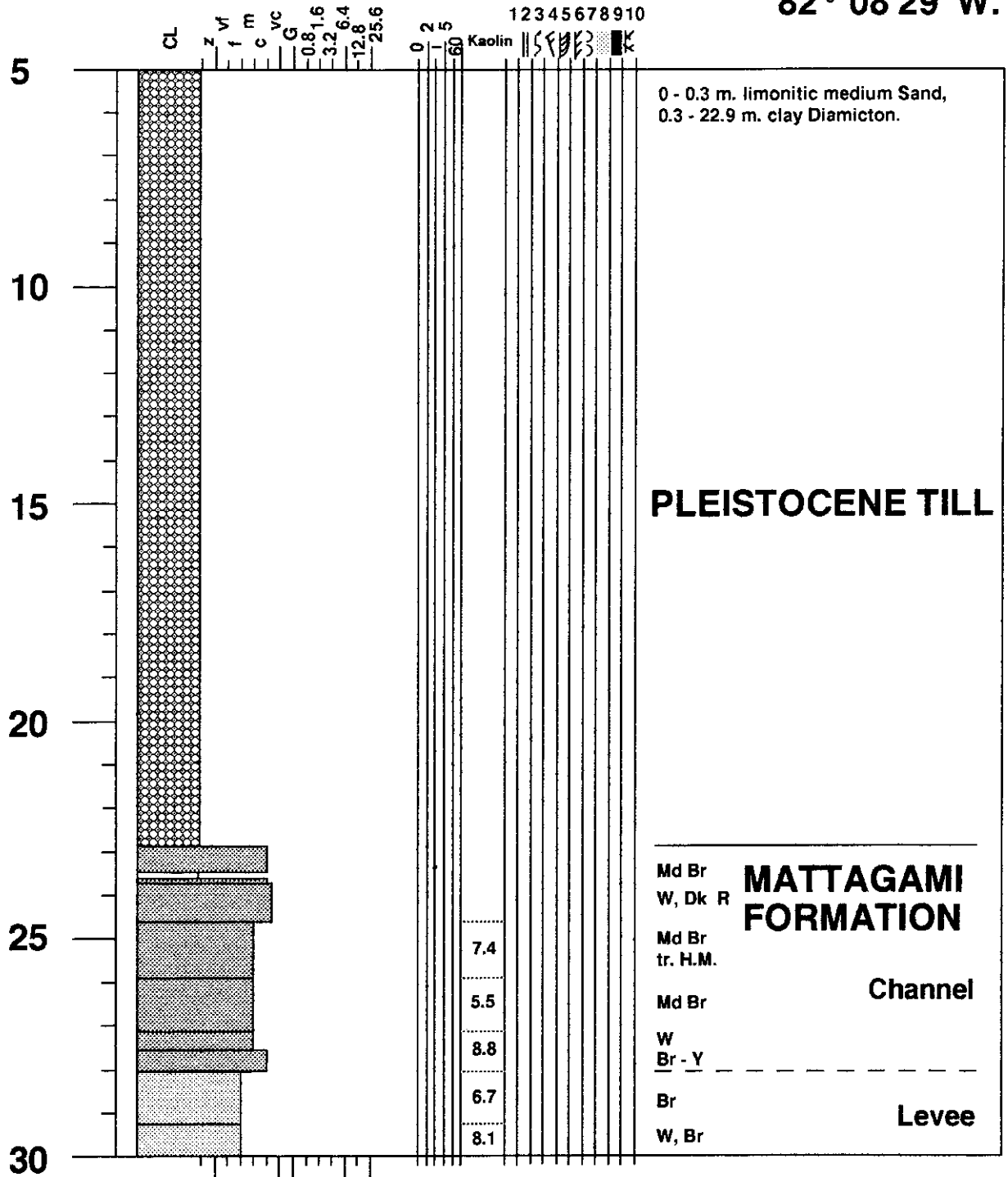
MRC hole 89 - 5, Kipling Twp.

50° 09'08"N,
82° 08'31"W.



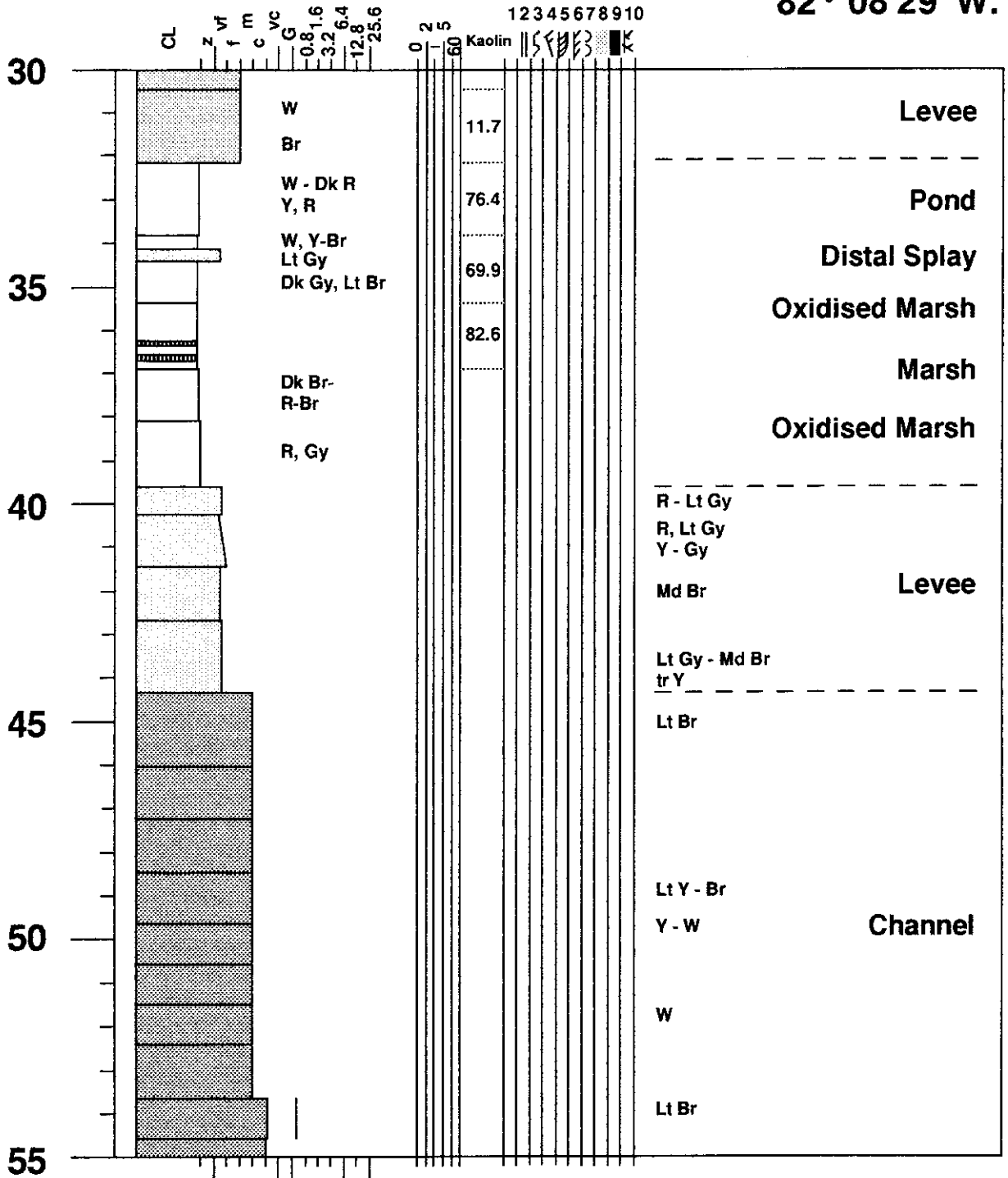
MRC hole 89 - 15, Kipling Twp.

50° 09'01"N,
82° 08'29"W.



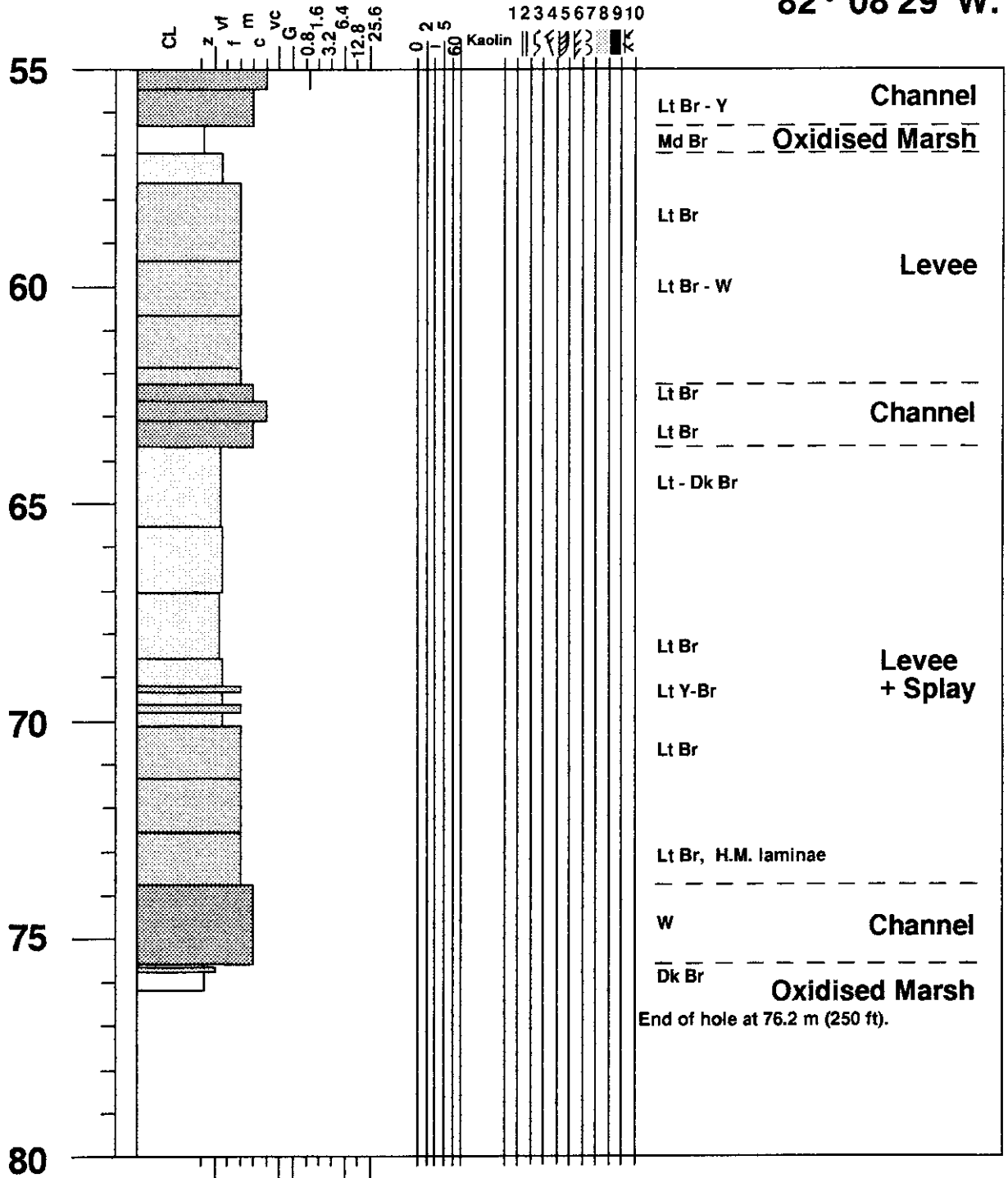
MRC hole 89 - 15, Kipling Twp.

50° 09'01"N,
82° 08'29"W.



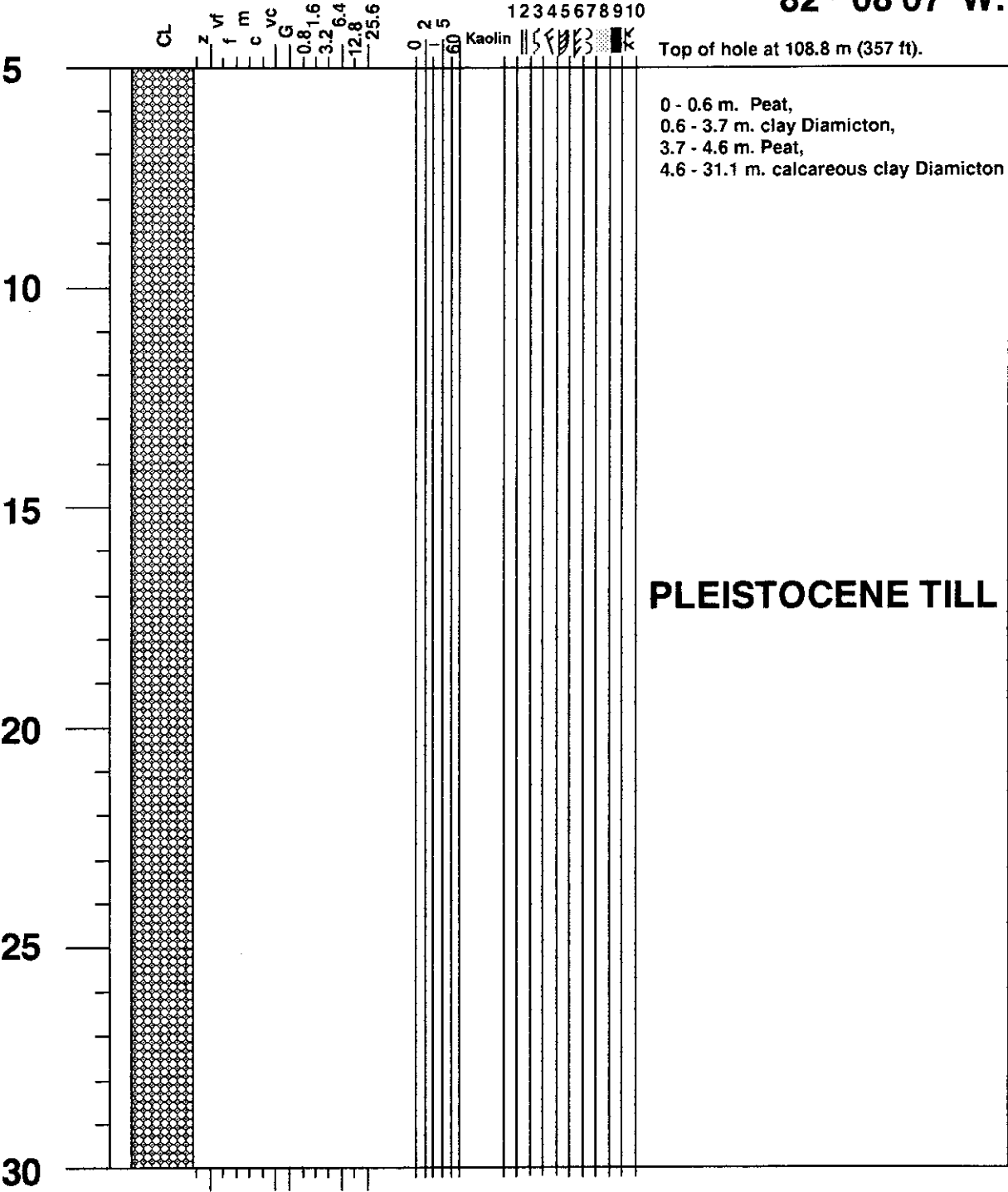
MRC hole 89 - 15, Kipling Twp.

50° 09'01"N,
82° 08'29"W.



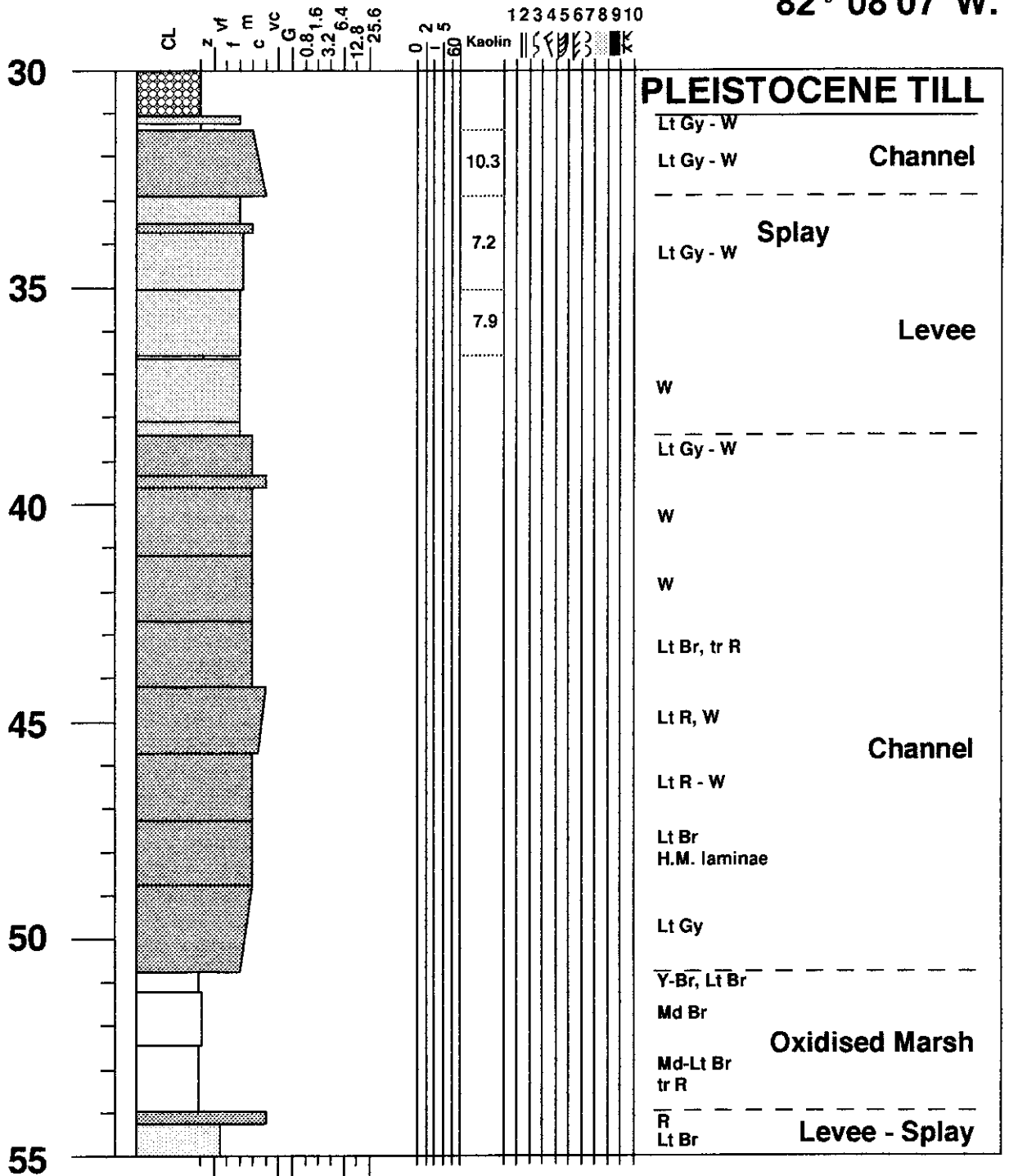
MRC hole 89 - 21, Kipling Twp.

50° 08'48"N,
82° 08'07"W.



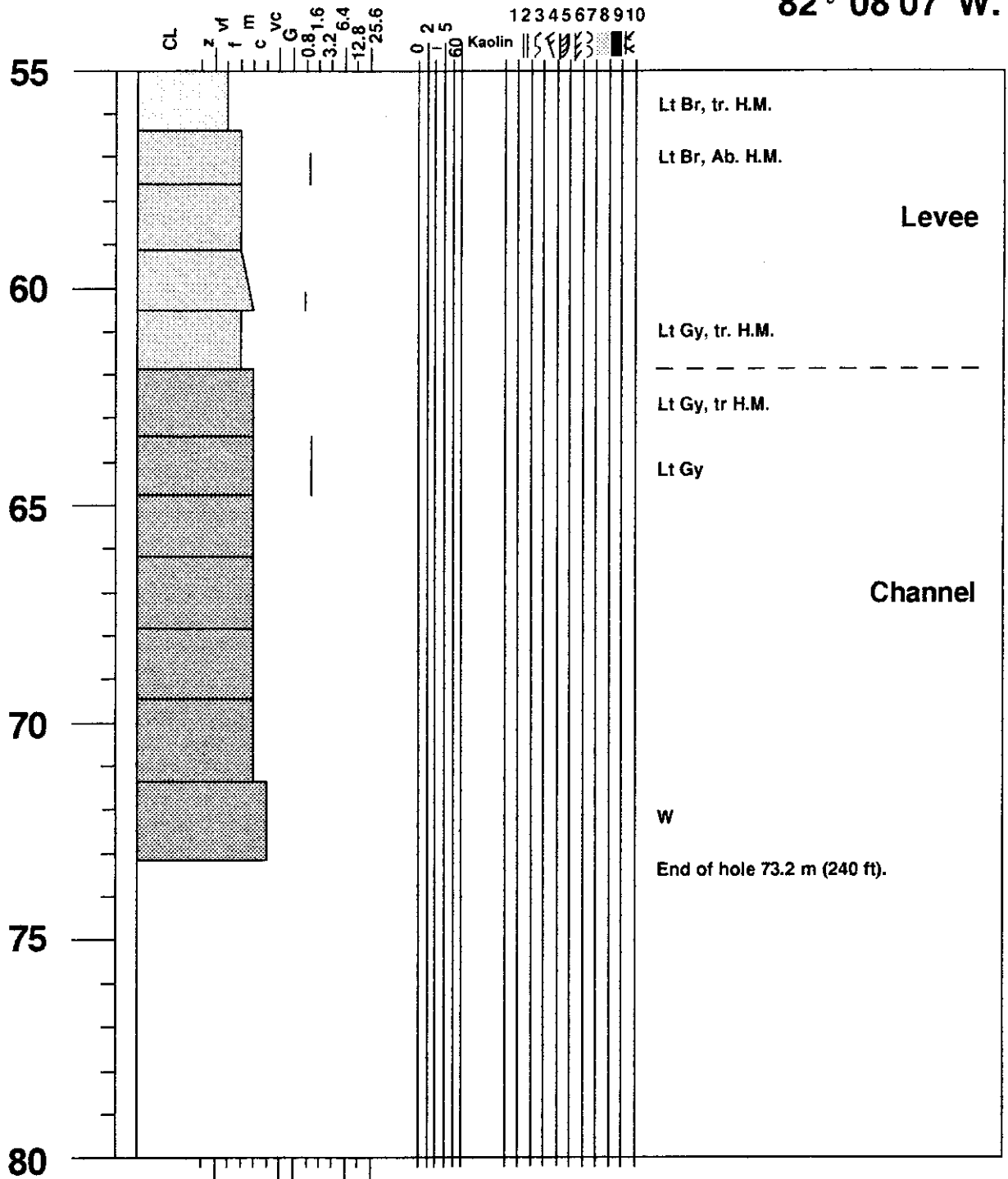
MRC hole 89 - 21, Kipling Twp.

50° 08'48"N,
82° 08'07"W.



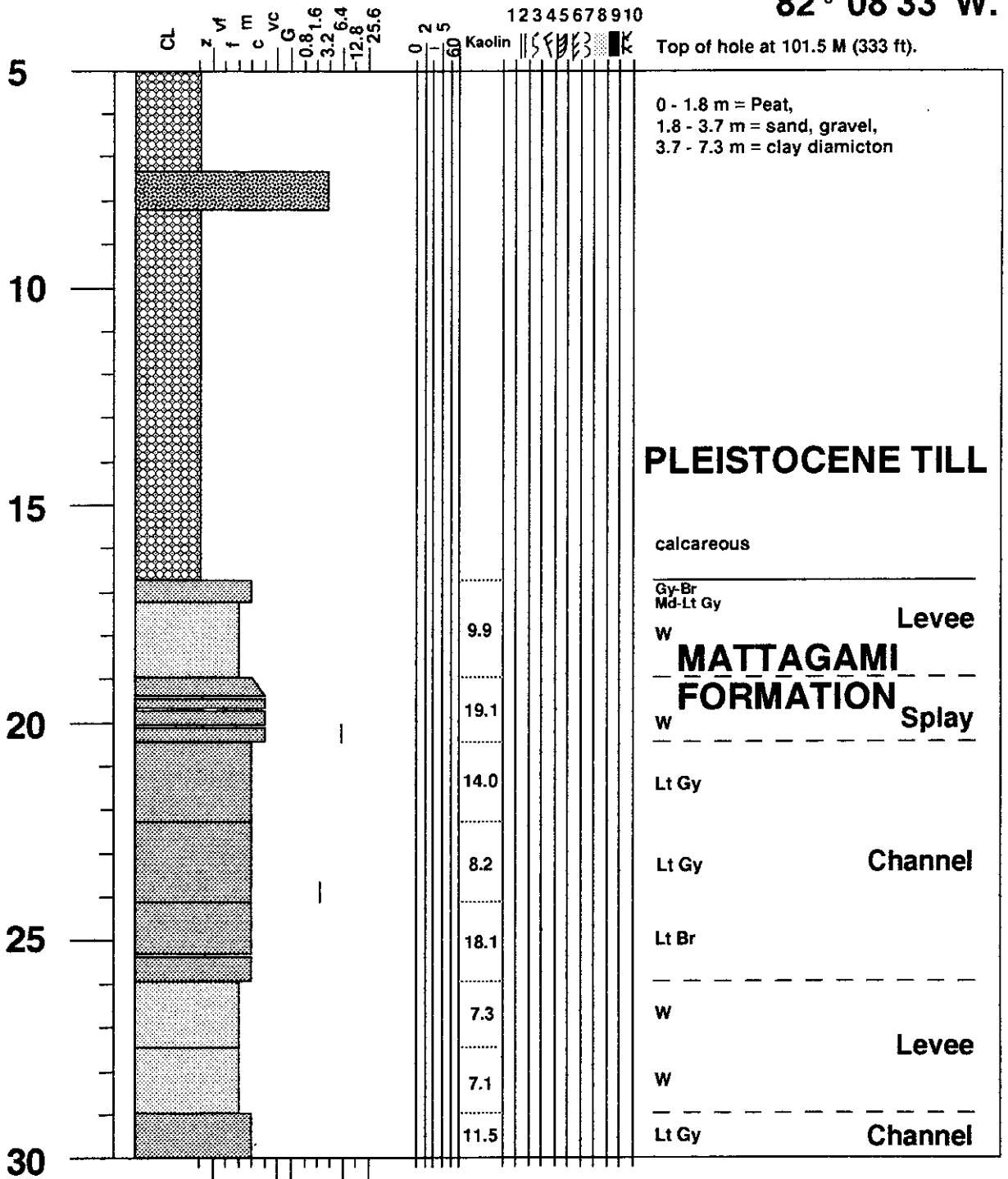
MRC hole 89 - 21, Kipling Twp.

50° 08'48"N,
82° 08'07"W.



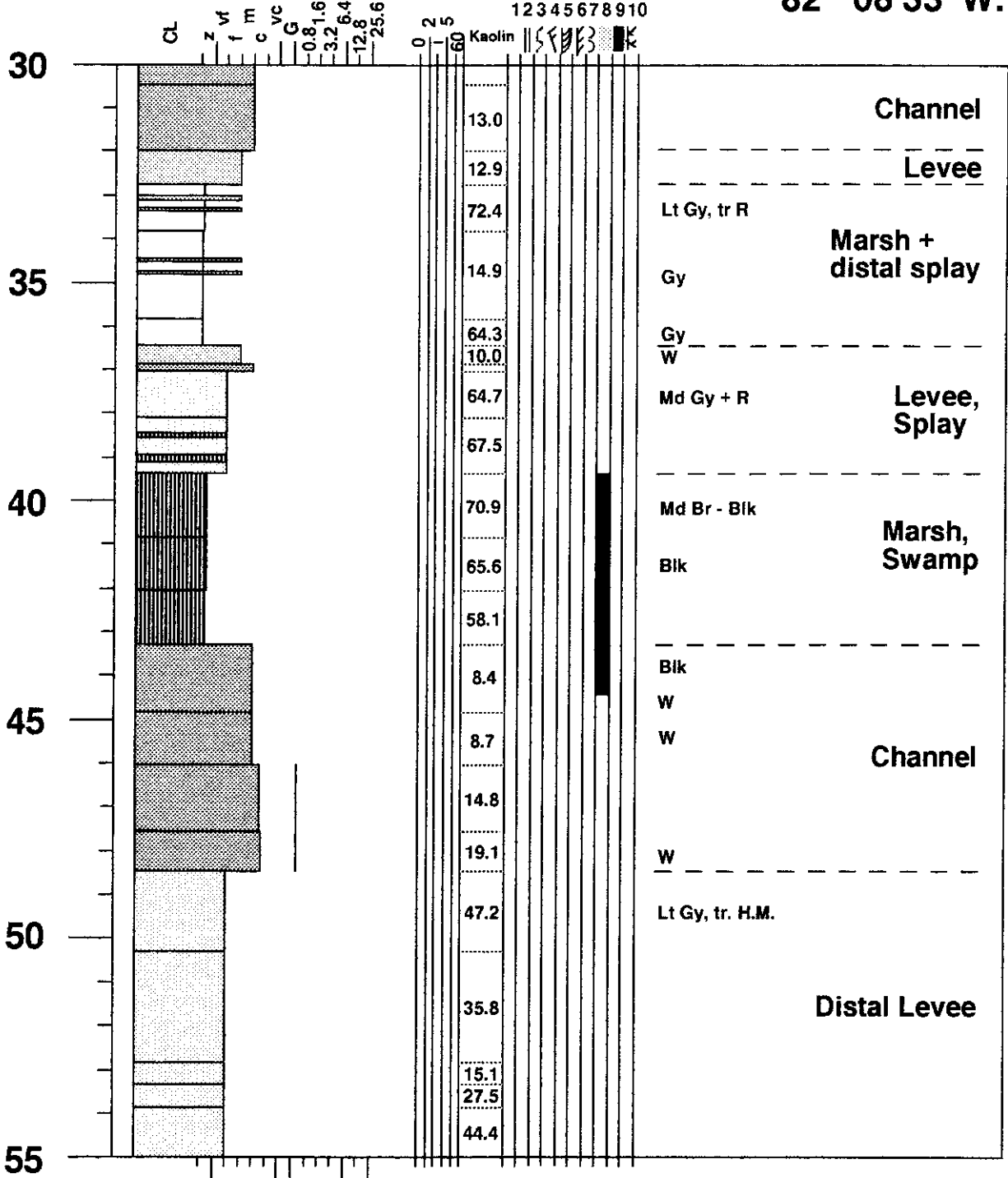
MRC hole 89 - 23, Kipling Twp.

50° 08'51"N,
82° 08'33"W.



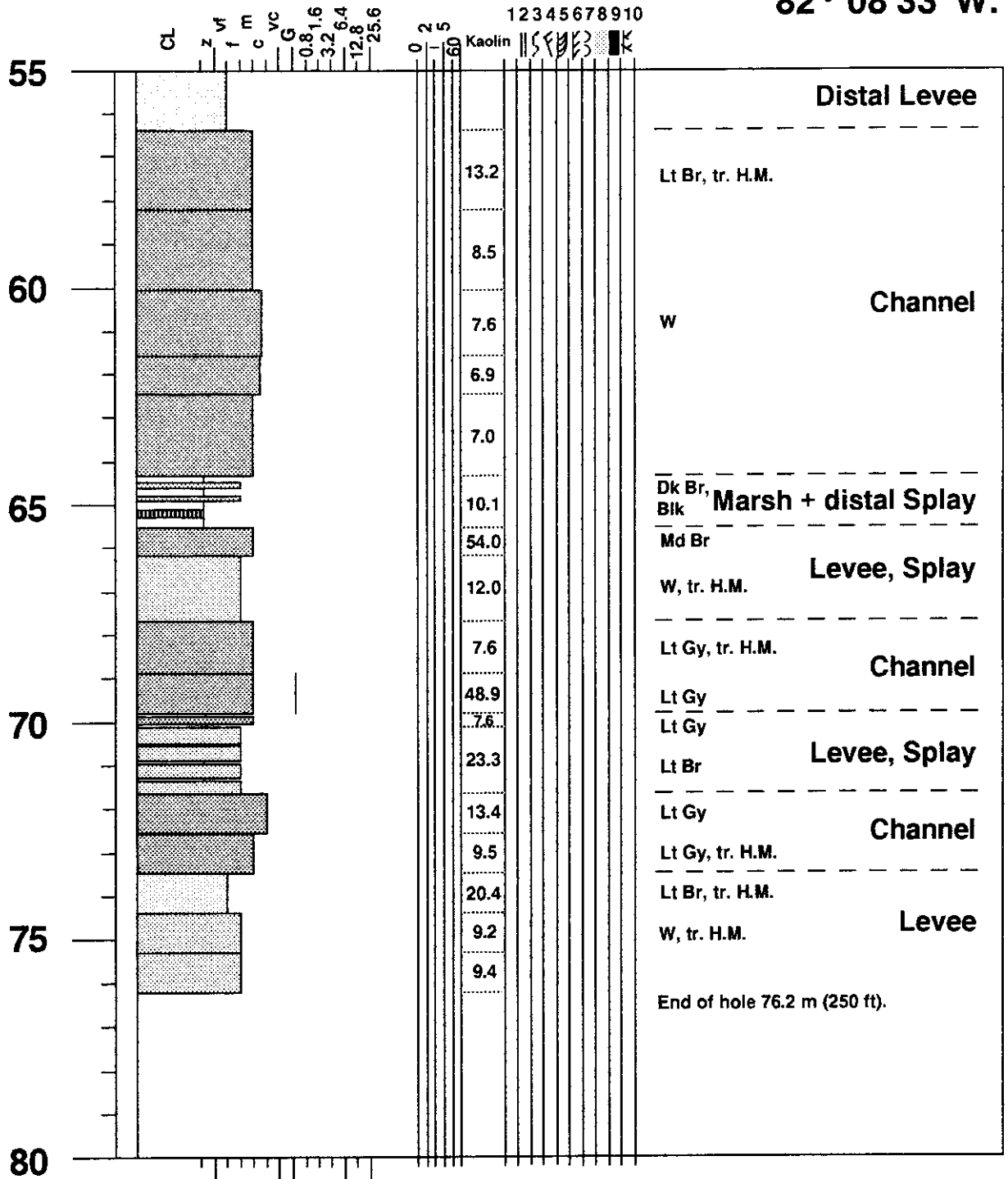
MRC hole 89 - 23, Kipling Twp.

50° 08'51"N,
82° 08'33"W.



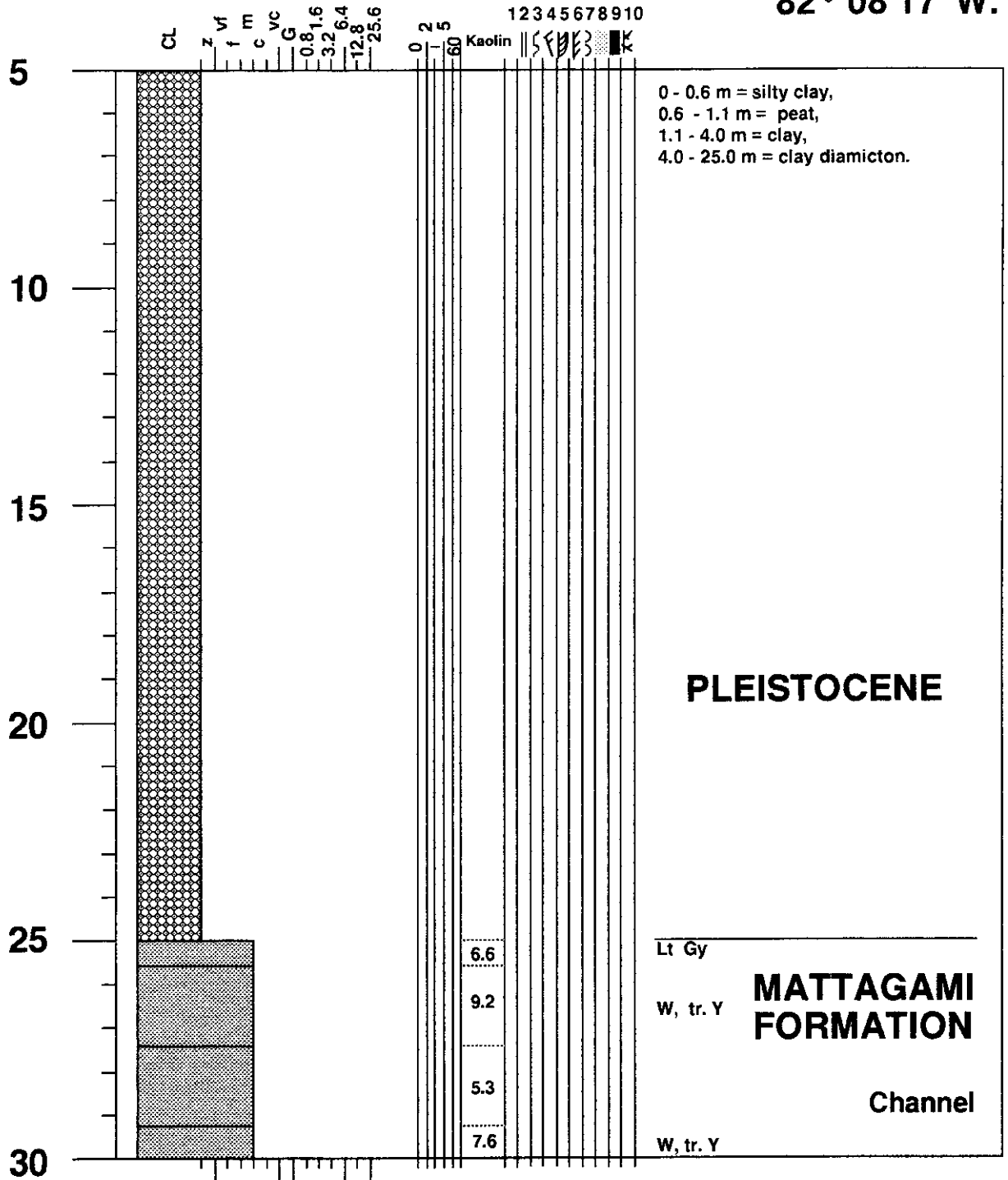
MRC hole 89 - 23, Kipling Twp.

50° 08'51"N,
82° 08'33"W.



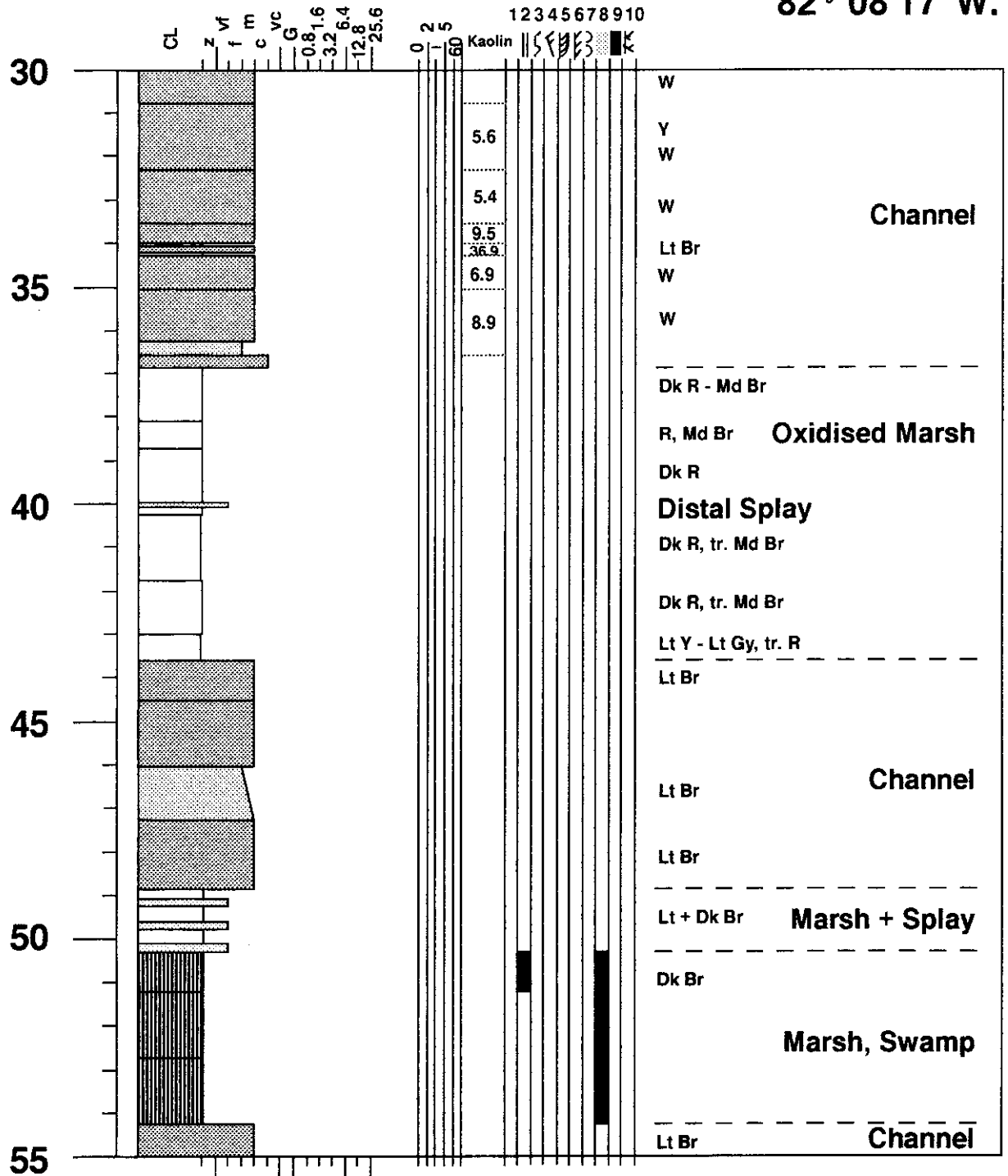
MRC hole 89 - 25, Kipling Twp.

50° 08'55"N,
82° 08'17"W.



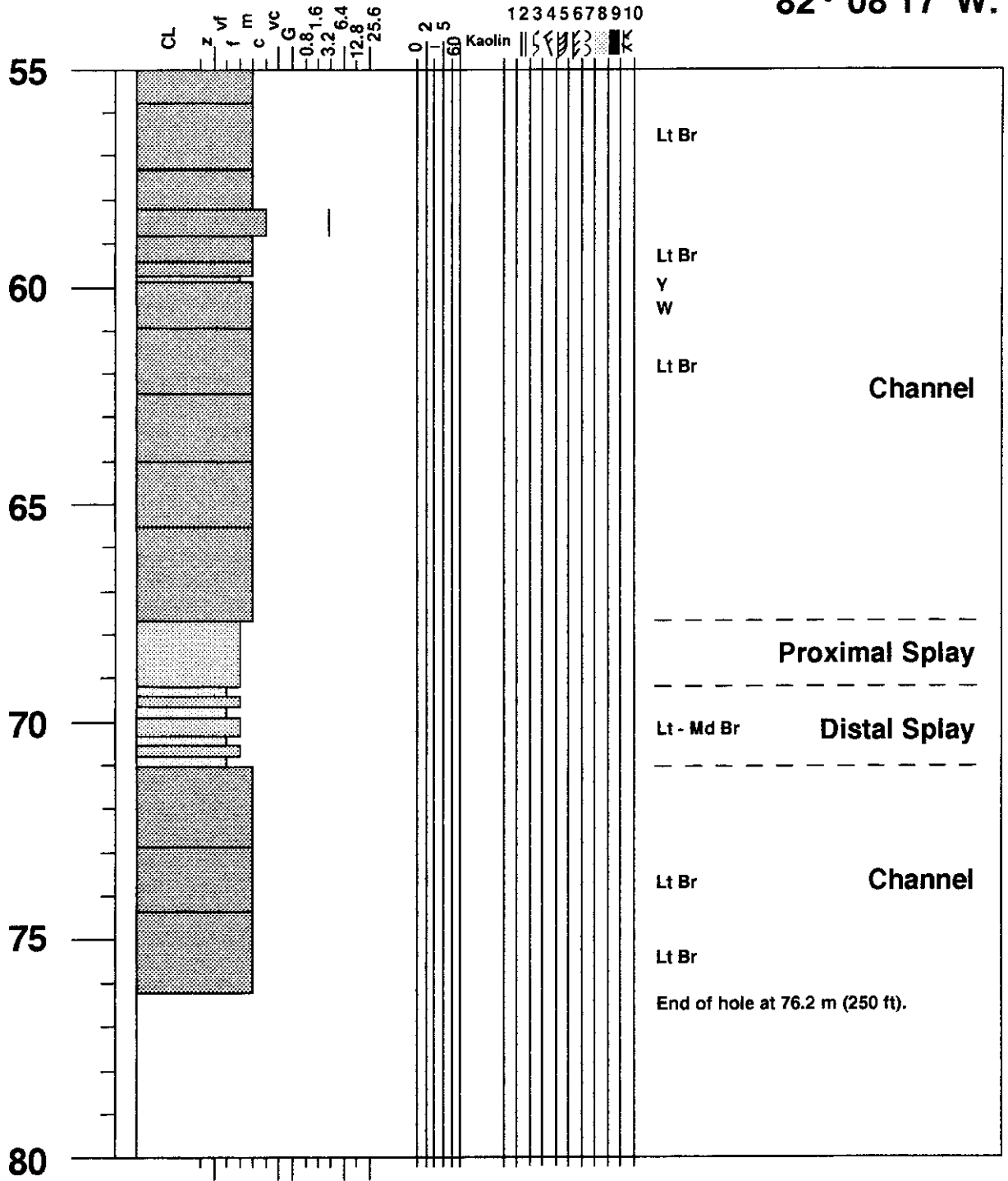
MRC hole 89 - 25, Kipling Twp.

50° 08'55"N,
82° 08'17"W.



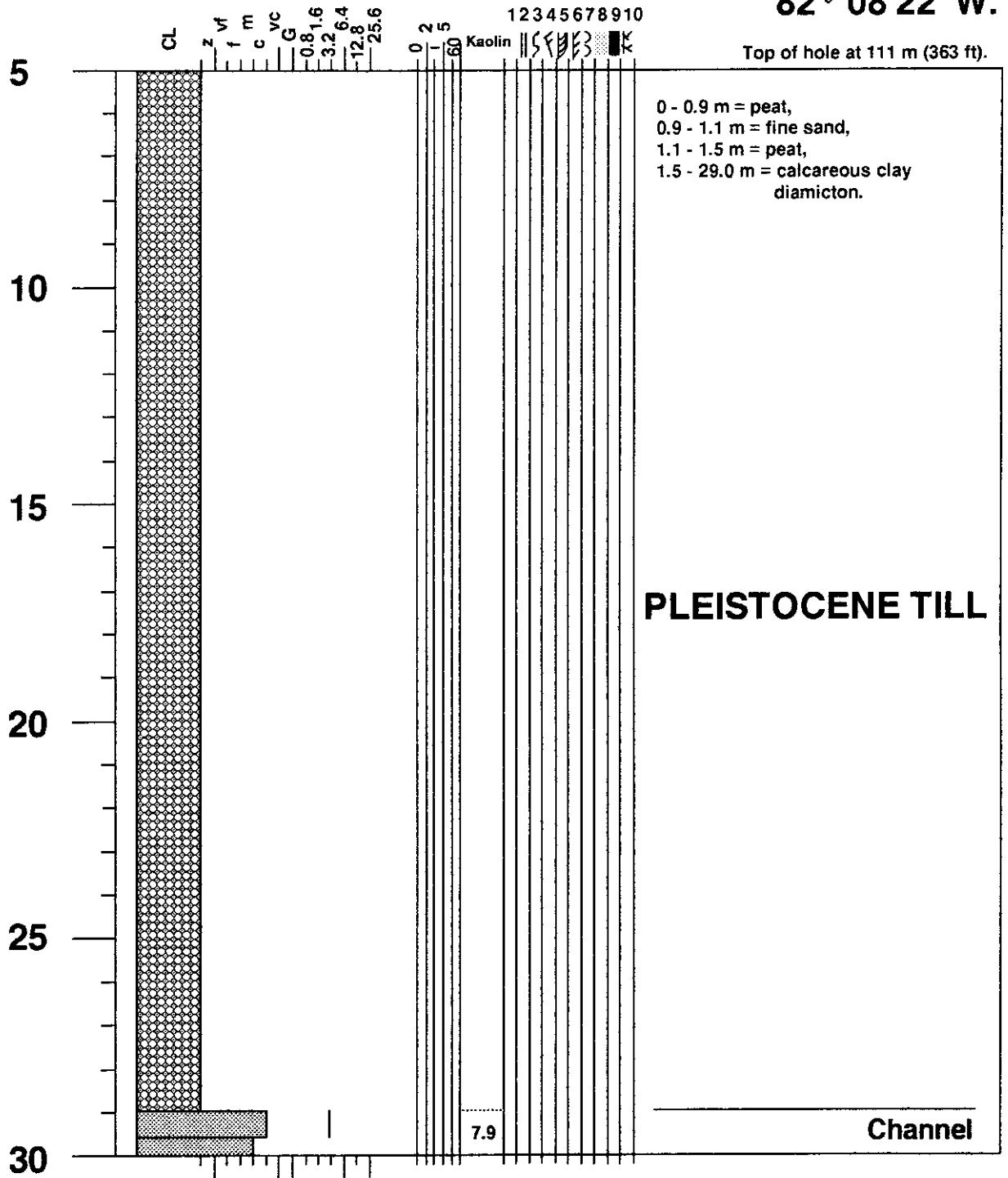
MRC hole 89 - 25, Kipling Twp.

**50° 08'55"N,
82° 08'17"W.**



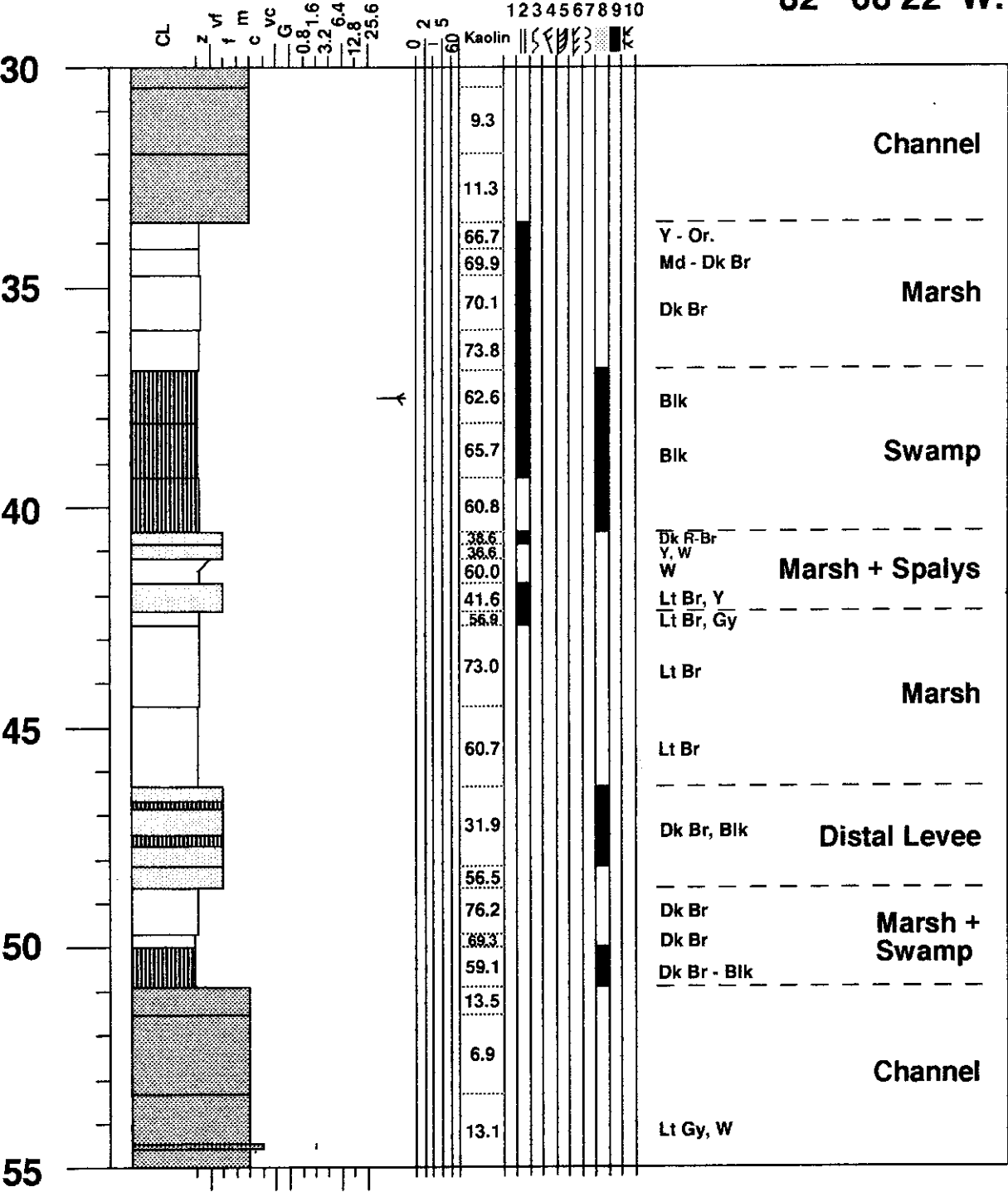
MRC hole 89 - 26, Kipling Twp.

50° 09'07"N,
82° 08'22"W.



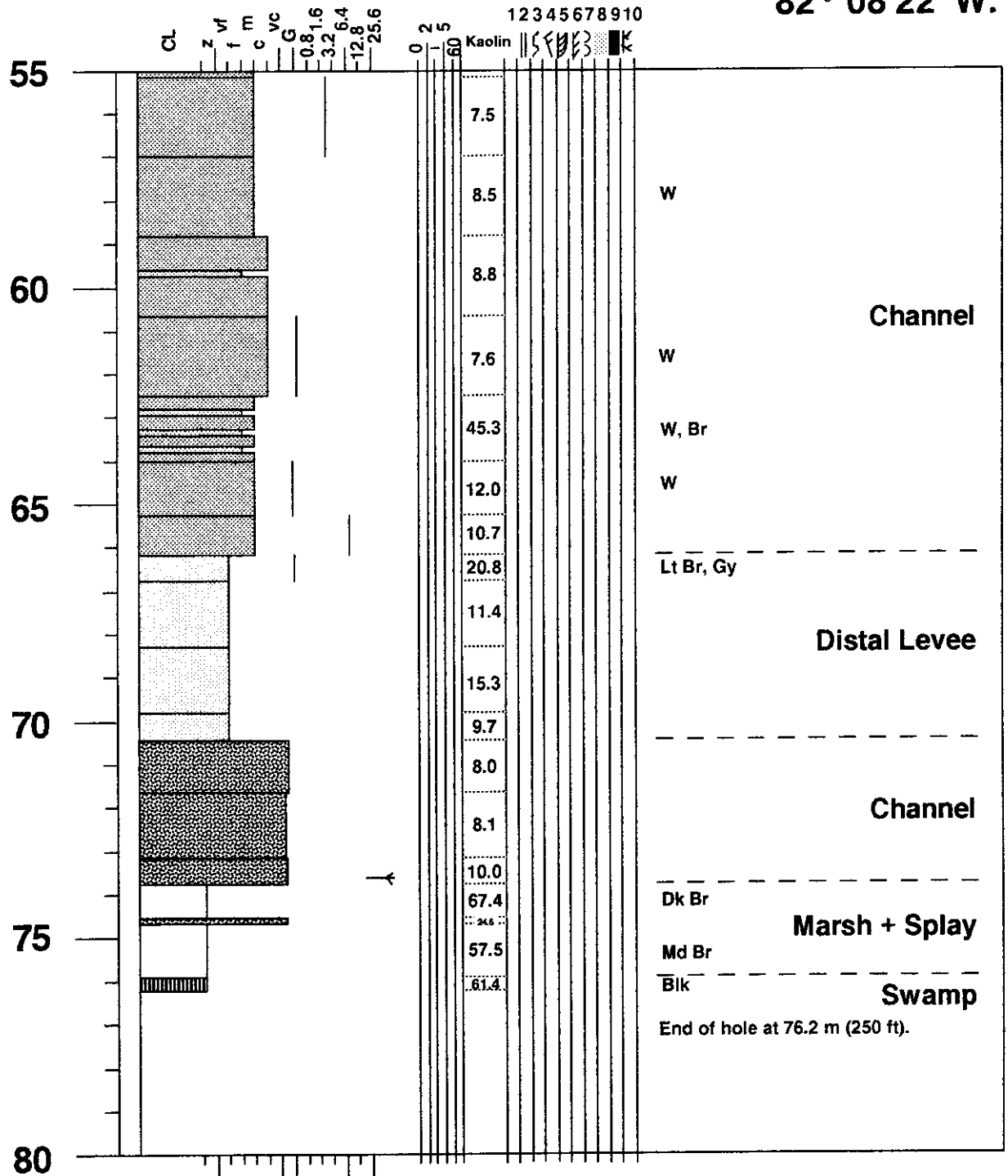
MRC hole 89 - 26, Kipling Twp.

50° 09'07"N,
82° 08'22"W.



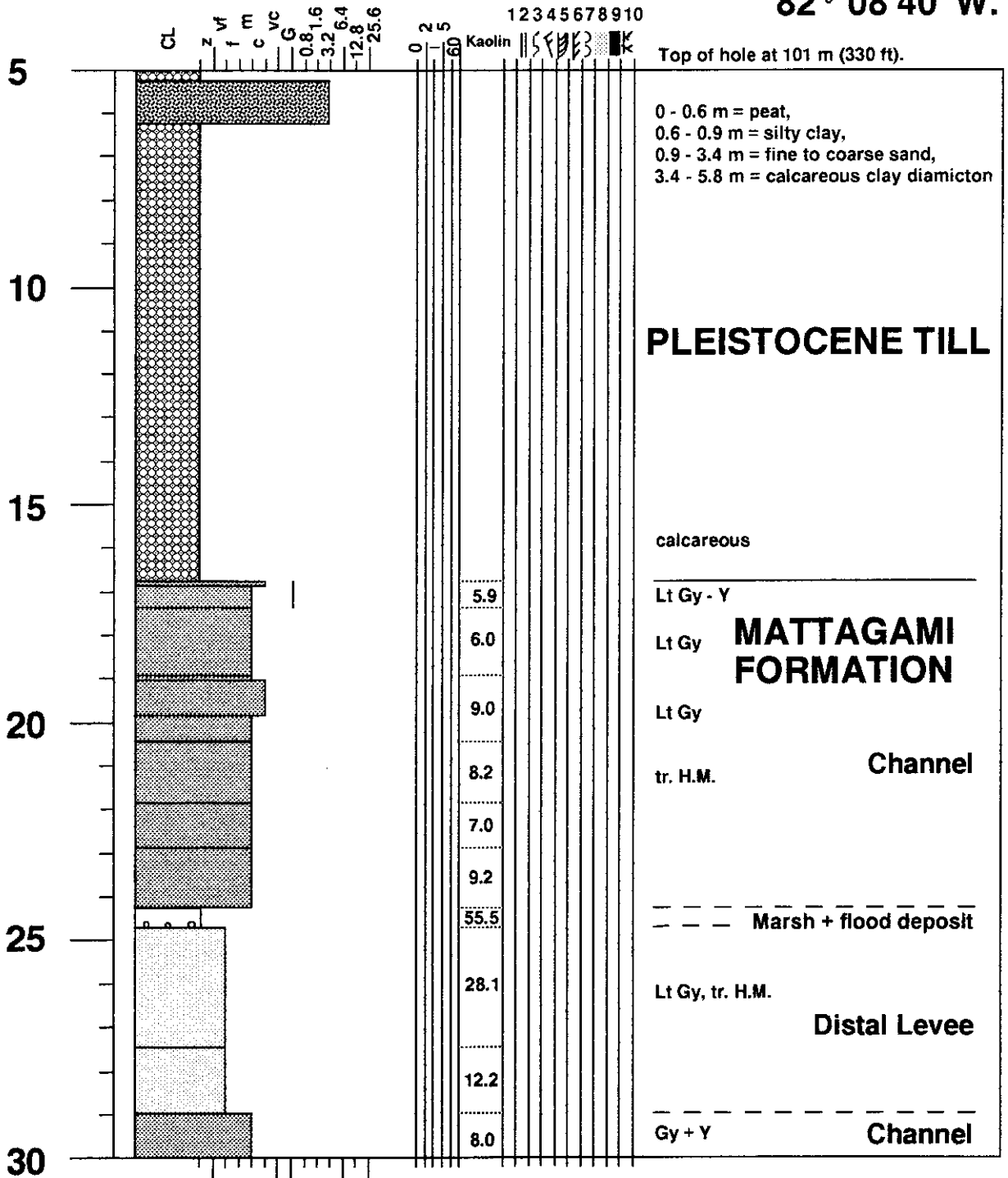
MRC hole 89 - 26, Kipling Twp.

50° 09'07"N,
82° 08'22"W.



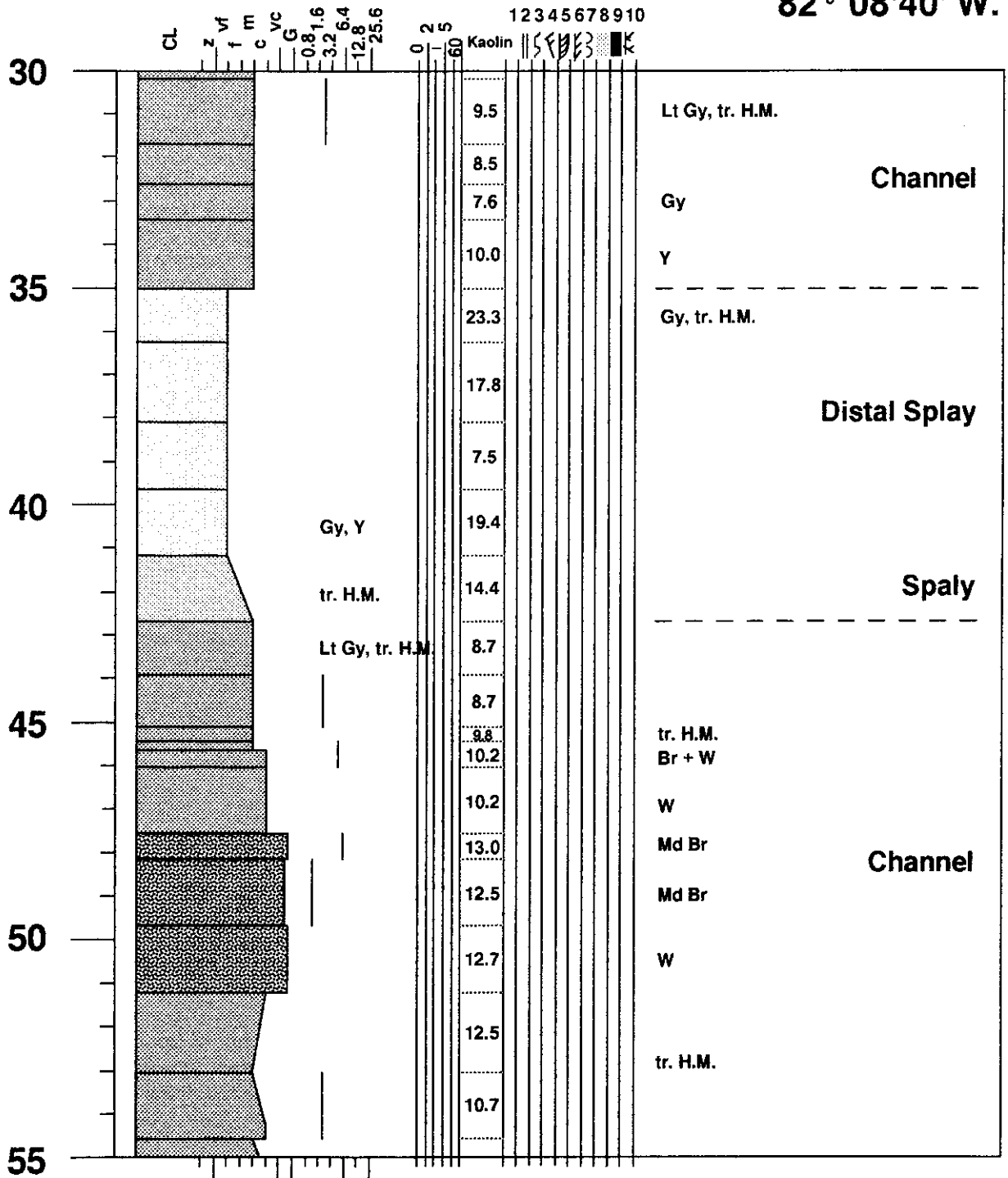
MRC hole 89 - 28, Kipling Twp.

50° 08'39"N,
82° 08'40"W.



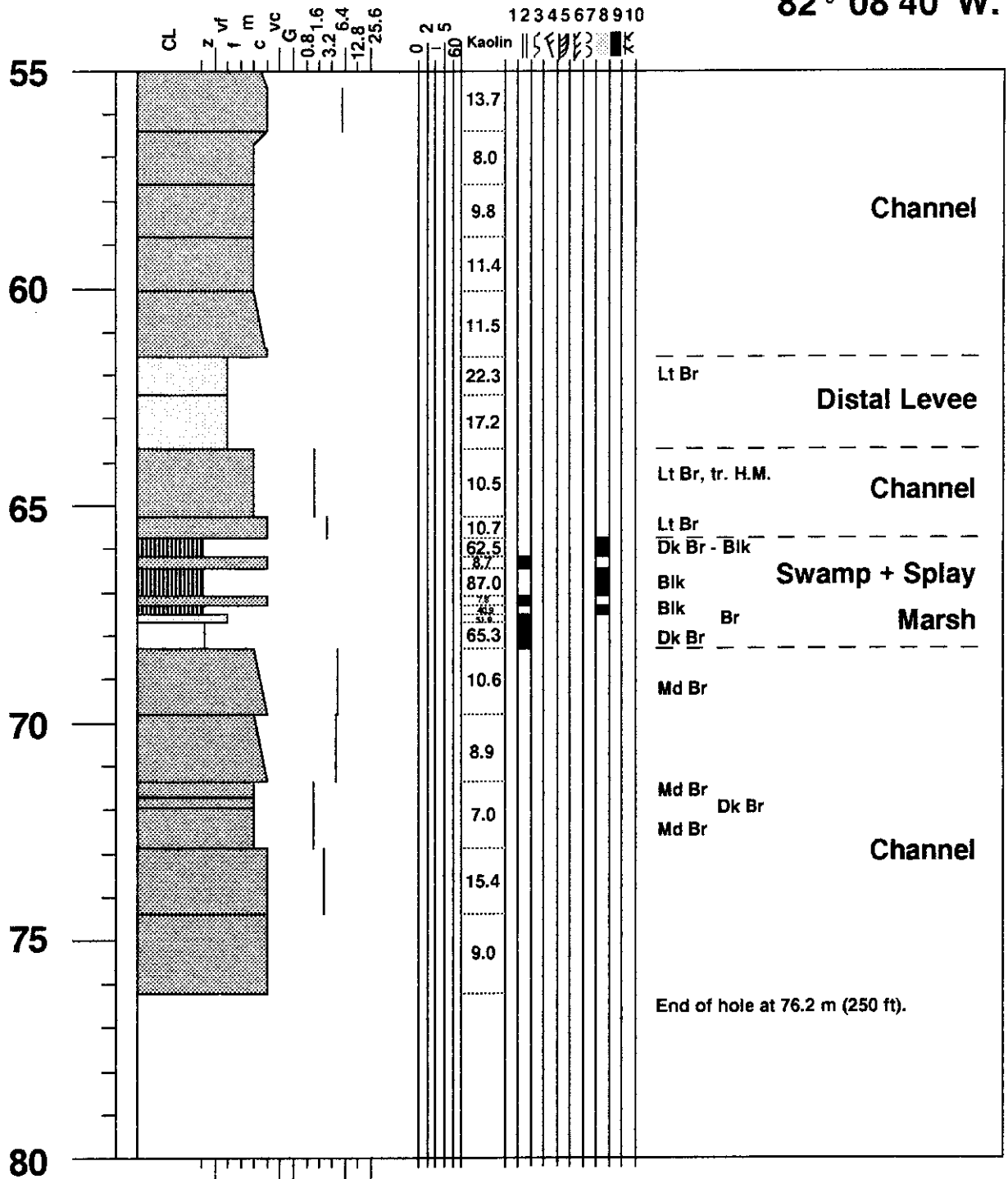
MRC hole 89 - 28, Kipling Twp.

50° 08'39"N,
82° 08'40"W.



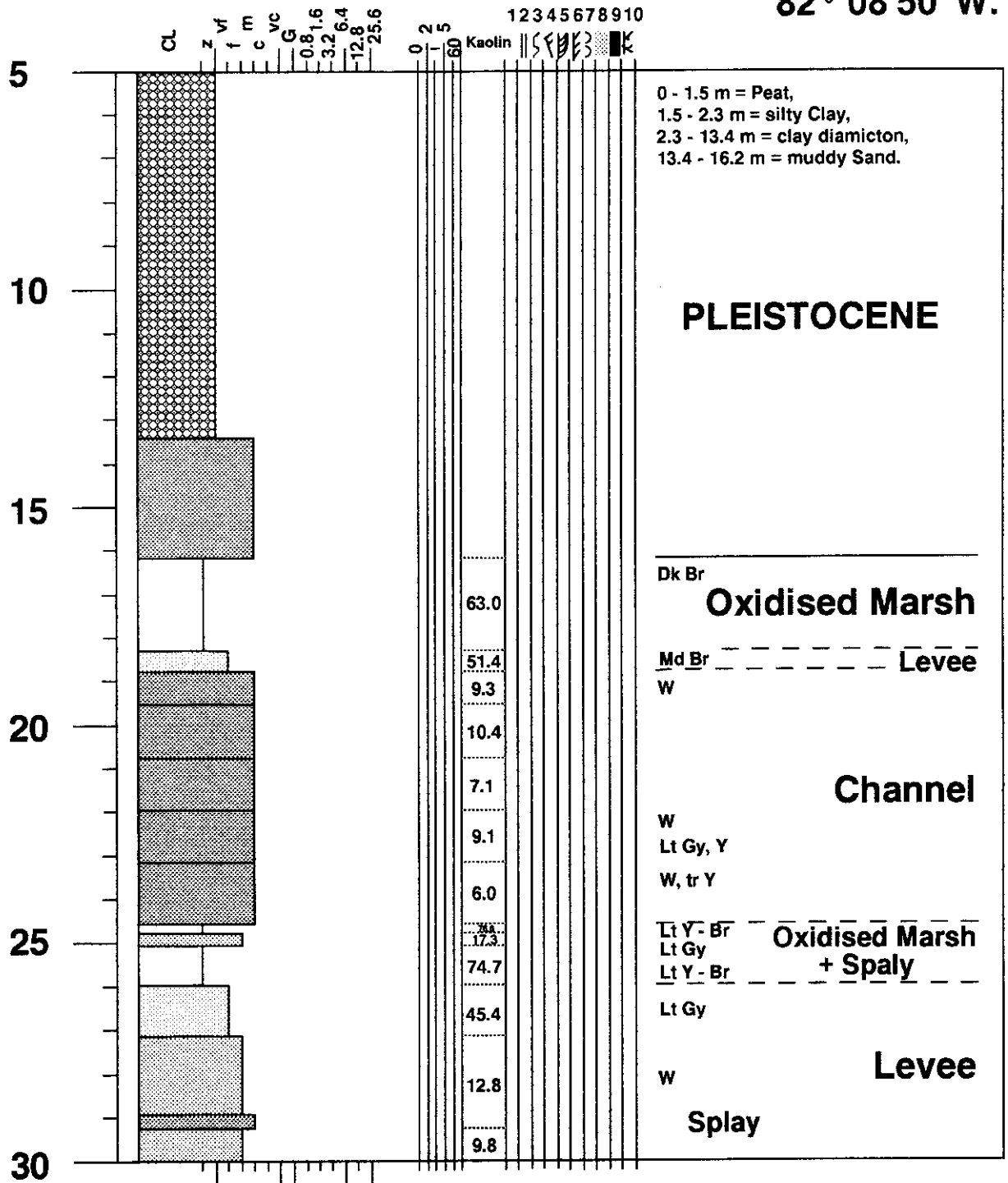
MRC hole 89 - 28, Kipling Twp.

50° 08'39"N,
82° 08'40"W.



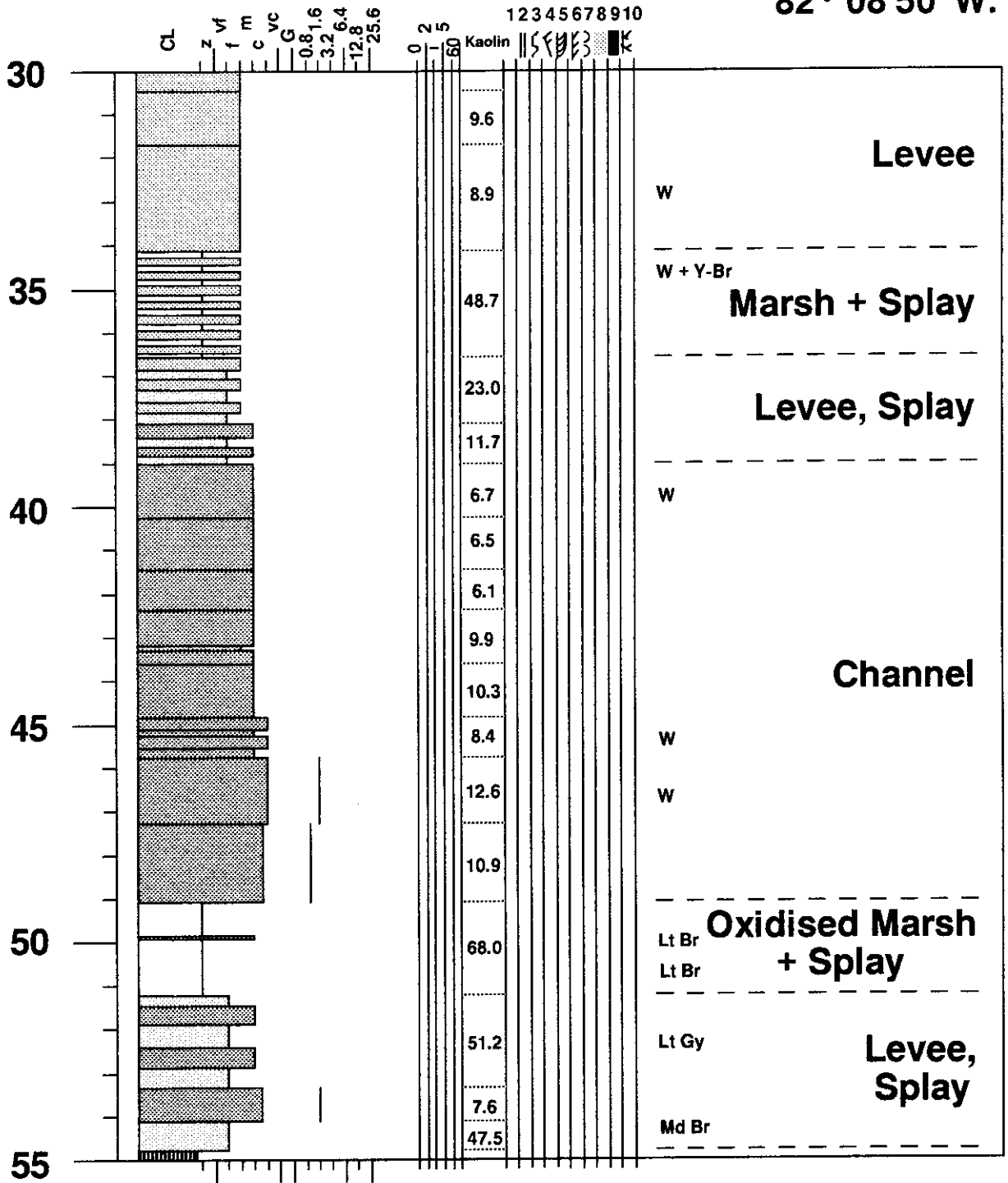
MRC hole 89 - 29, Kipling Twp.

50° 08'48"N,
82° 08'50"W.



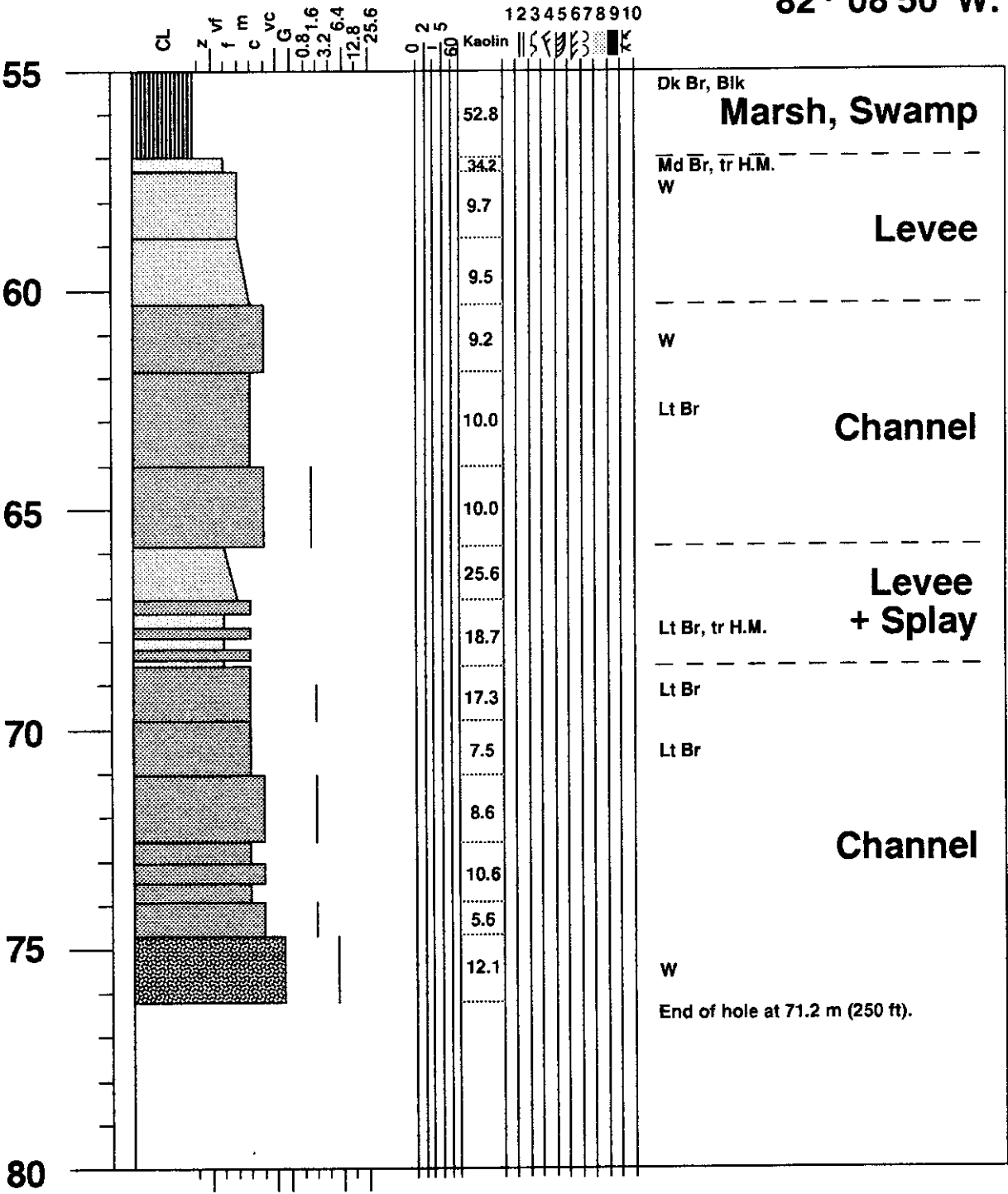
MRC hole 89 - 29, Kipling Twp.

50° 08'48"N,
82° 08'50"W.



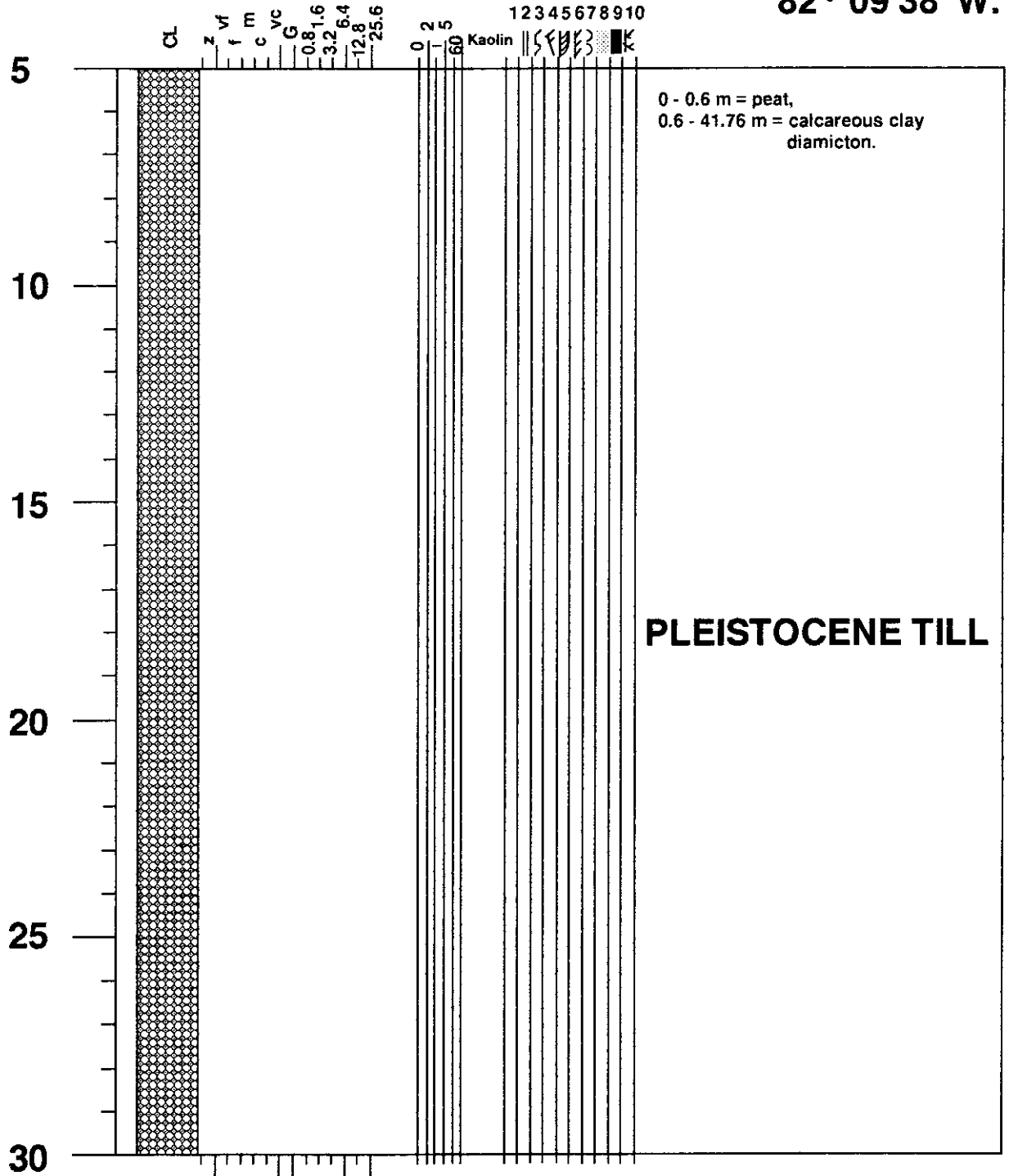
MRC hole 89 - 29, Kipling Twp.

50° 08'48"N,
82° 08'50"W.



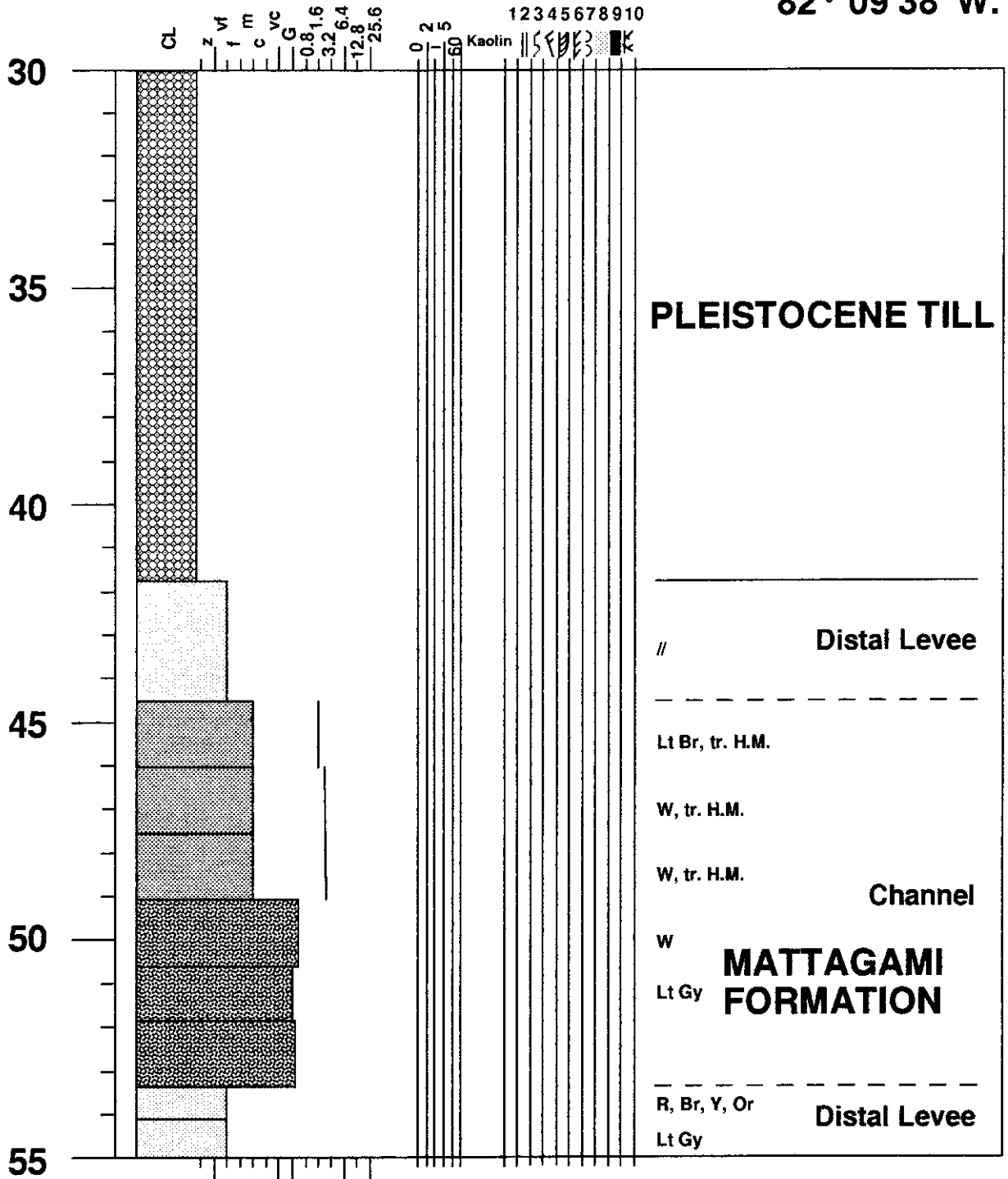
MRC hole 89 - 34, Kipling Twp.

50° 09'12"N,
82° 09'38"W.



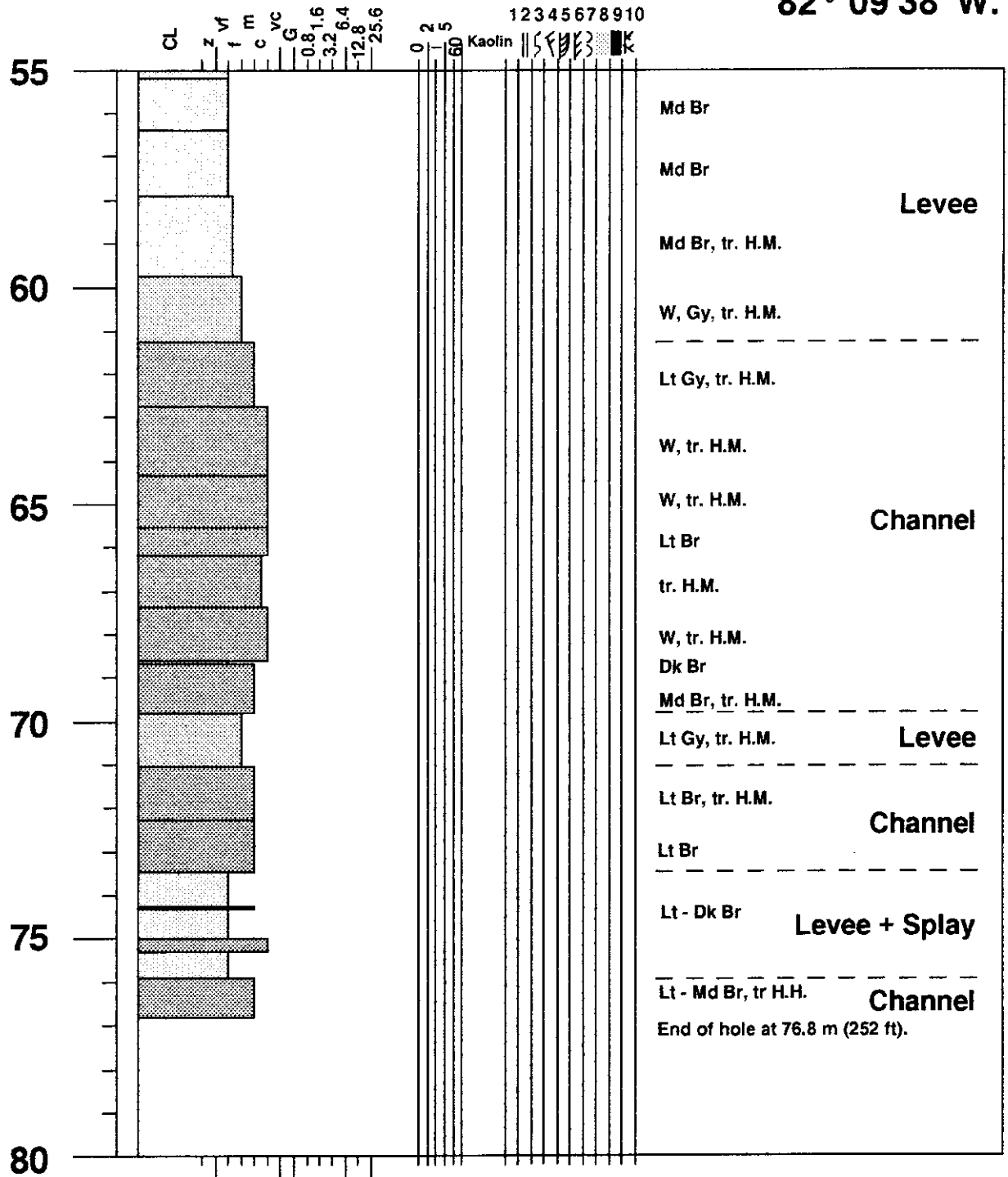
MRC hole 89 - 34, Kipling Twp.

**50° 09'12"N,
82° 09'38"W.**



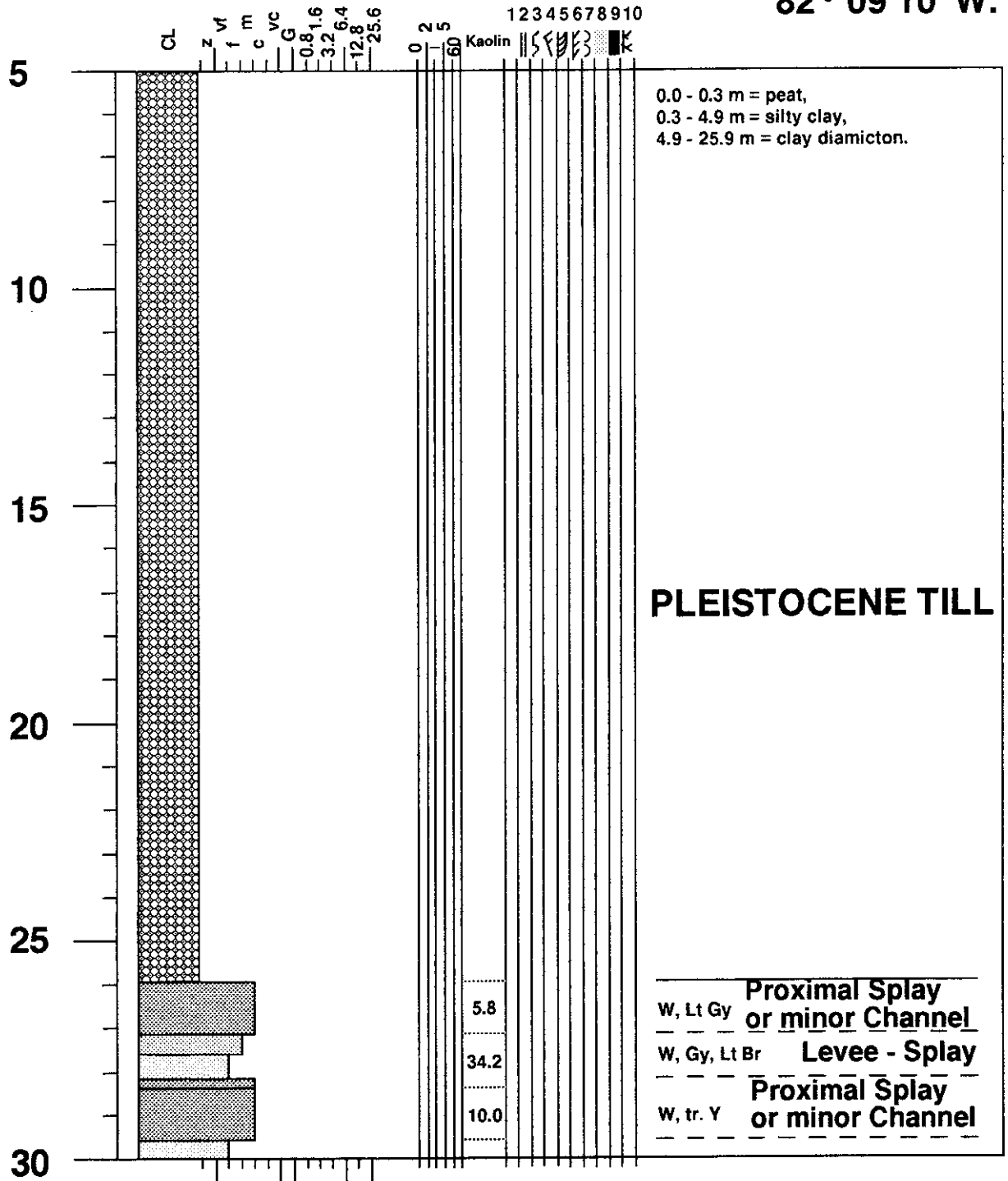
MRC hole 89 - 34, Kipling Twp.

50° 09'12"N,
82° 09'38"W.



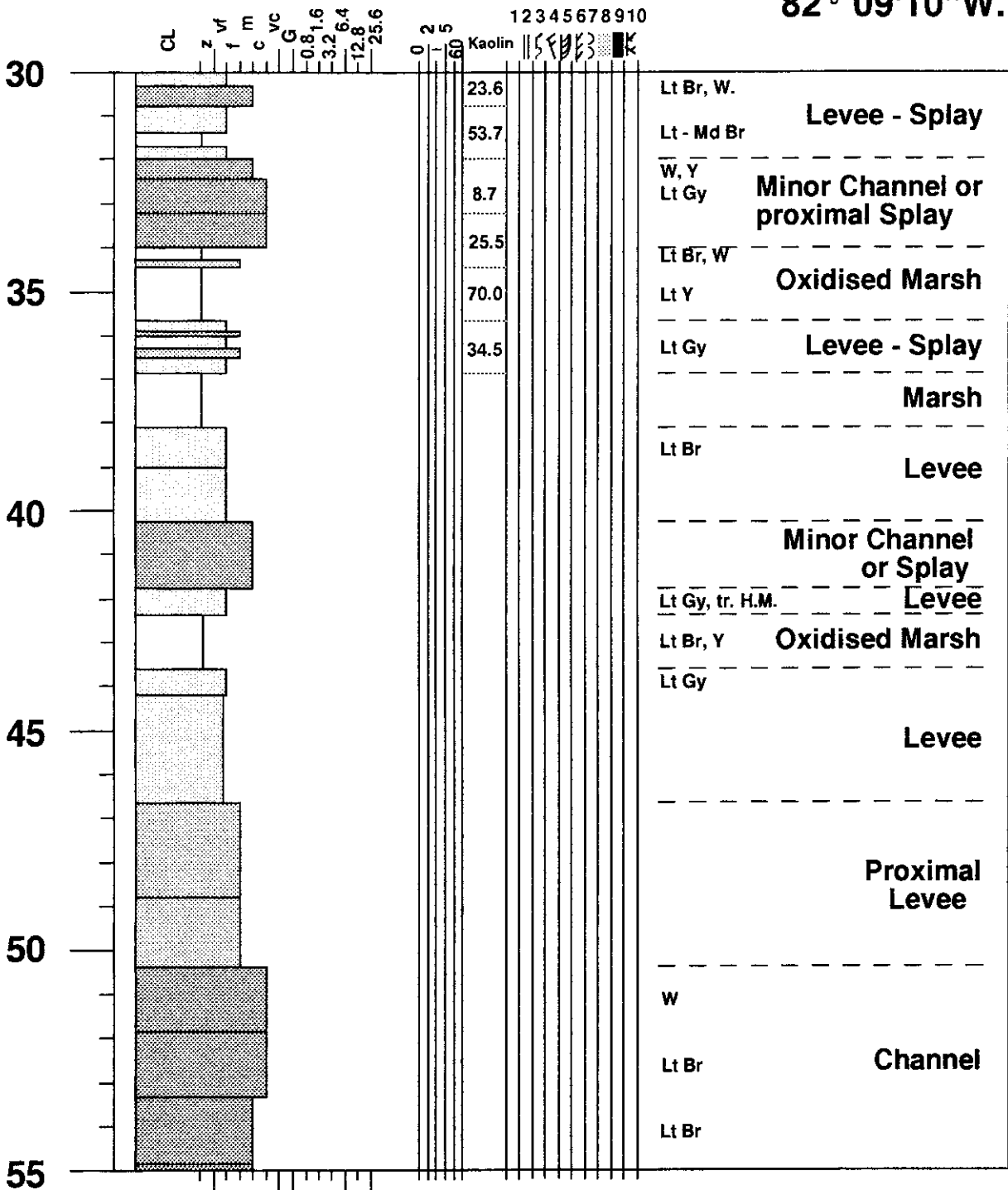
MRC hole 89 - 36, Kipling Twp.

50° 08'53"N,
82° 09'10"W.



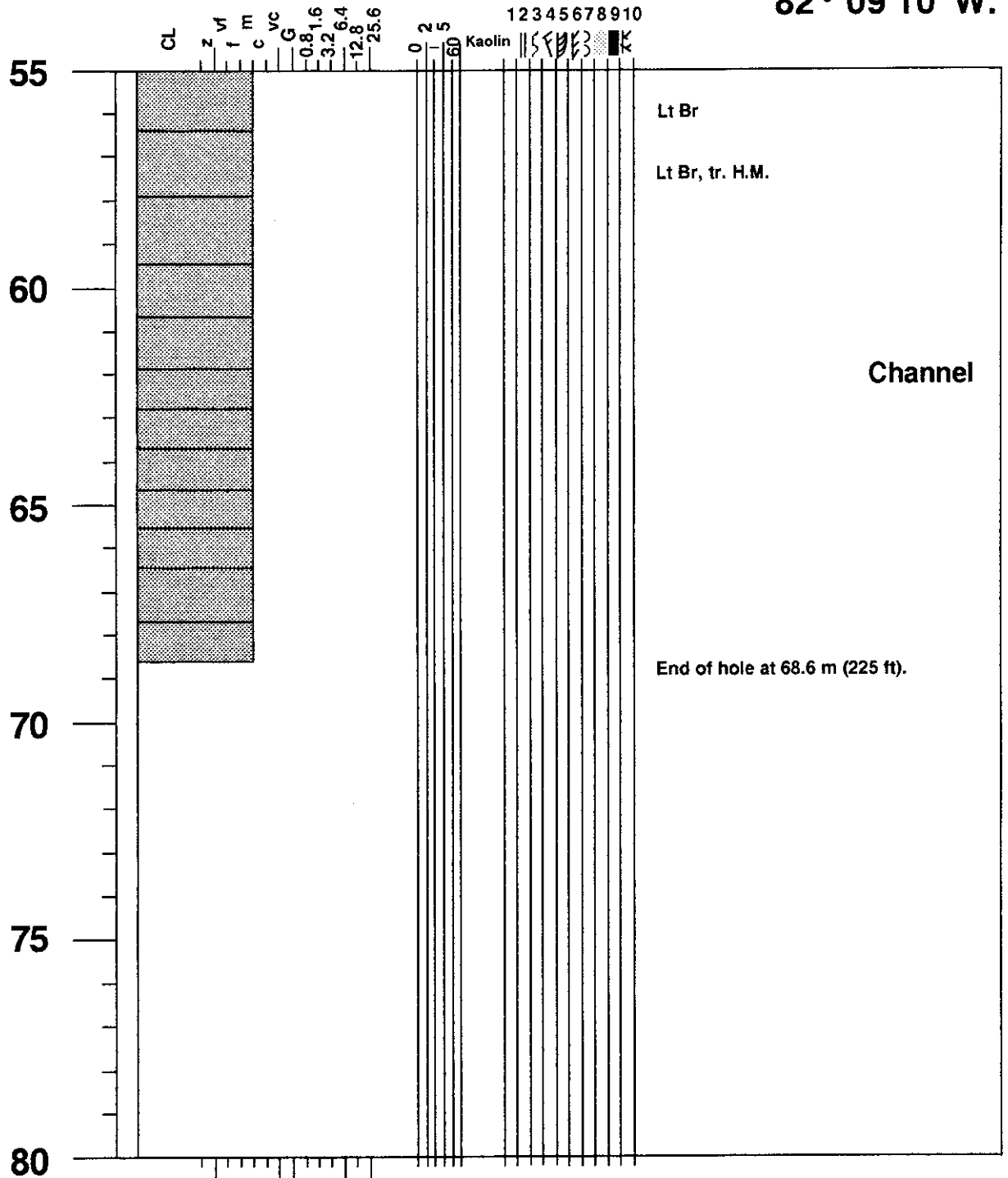
MRC hole 89 - 36, Kipling Twp.

50° 08'53"N,
82° 09'10"W.



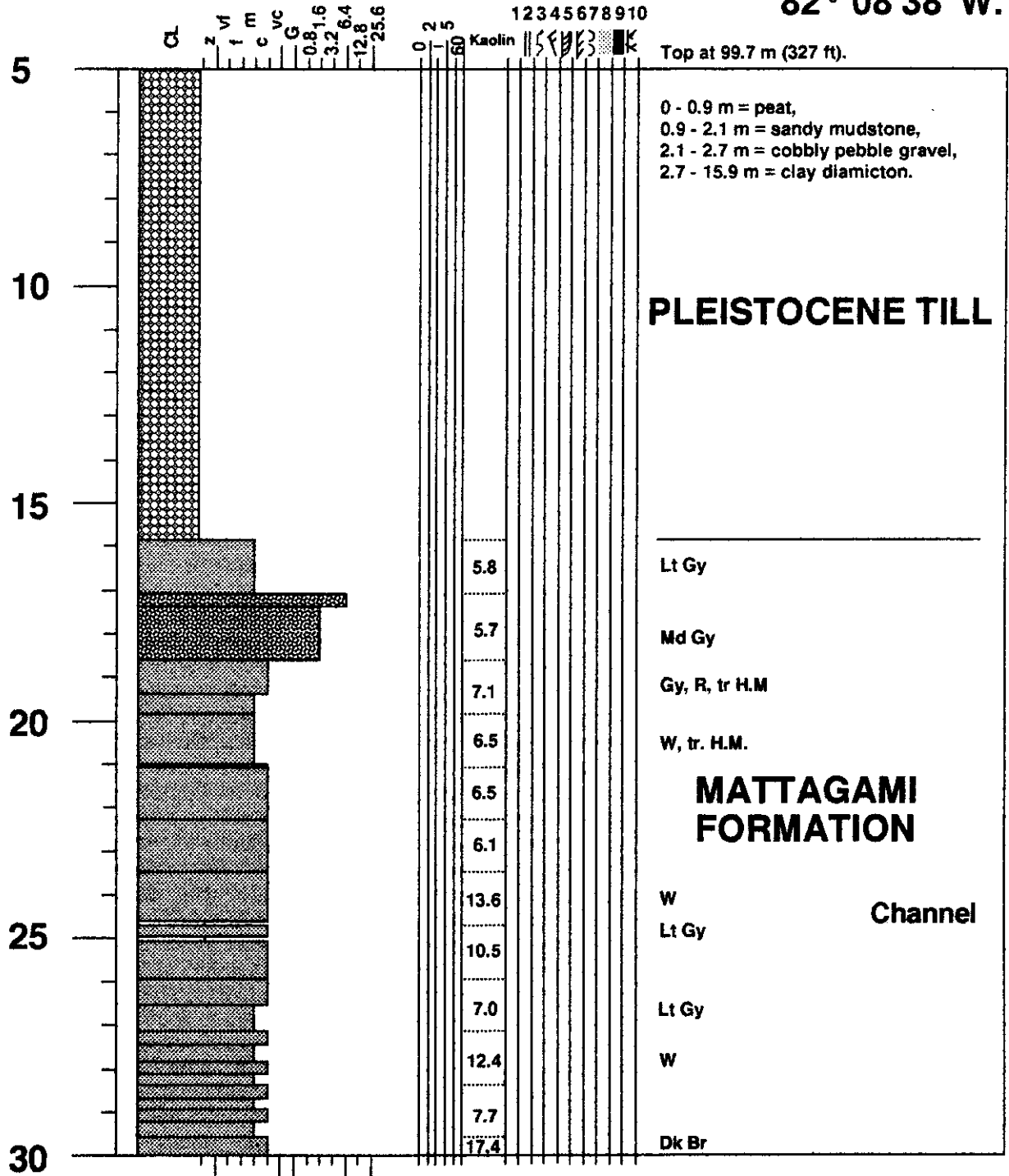
MRC hole 89 - 36, Kipling Twp.

50° 08'53"N,
82° 09'10"W.



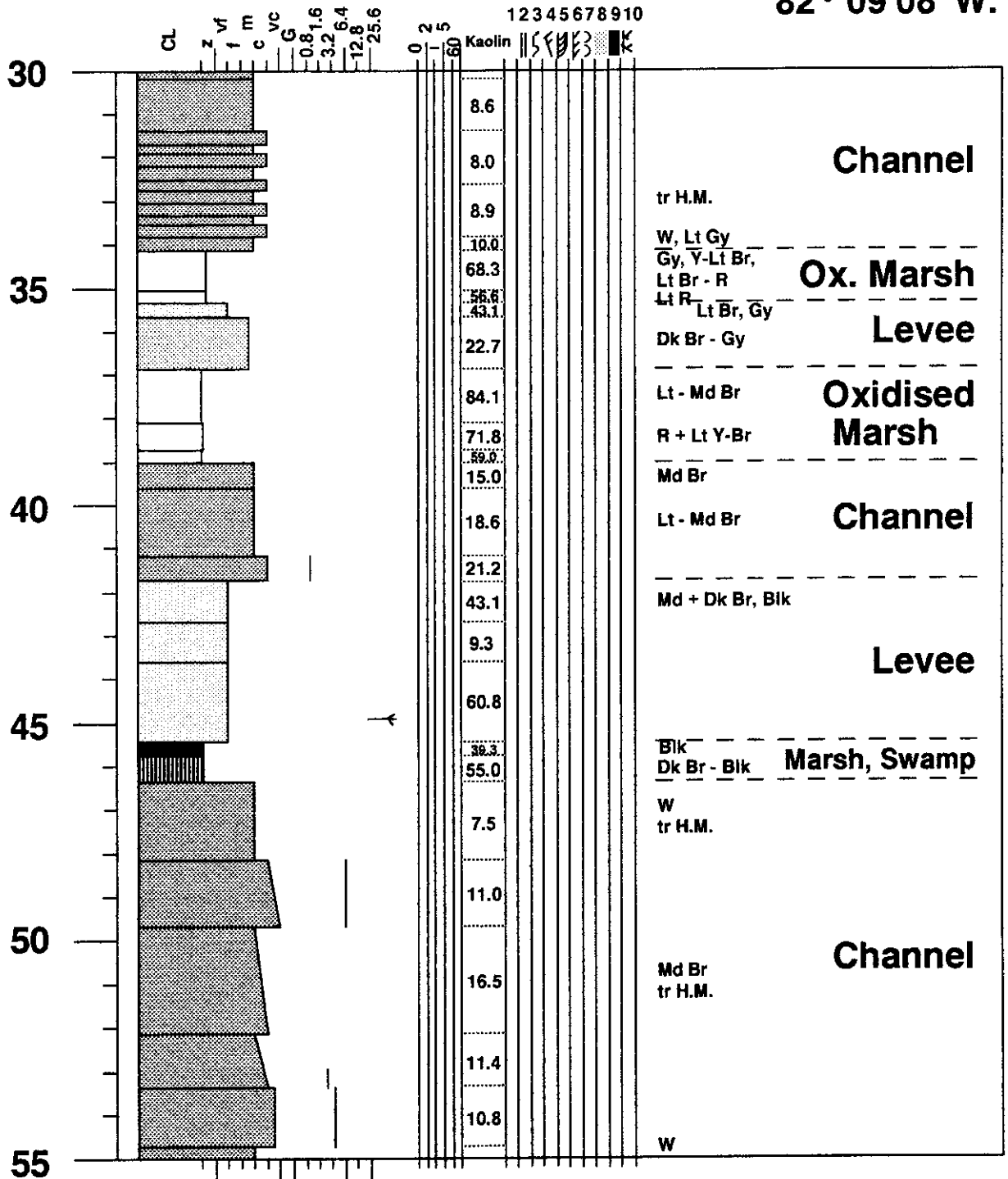
MRC hole 89 - 87, Kipling Twp.

50° 08'52"N,
82° 08'38"W.



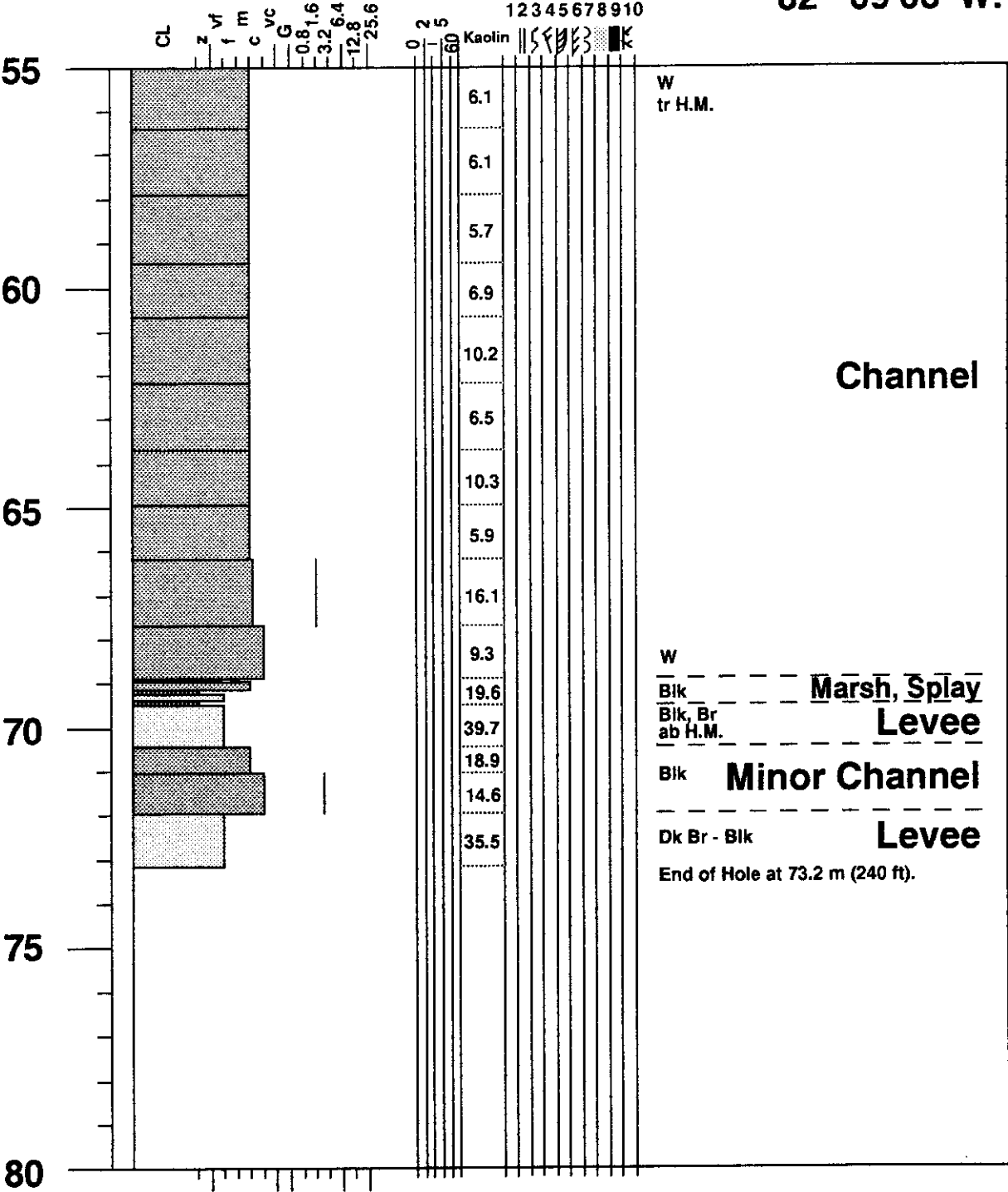
MRC hole 89 - 37, Kipling Twp.

50° 08'48"N,
82° 09'08"W.



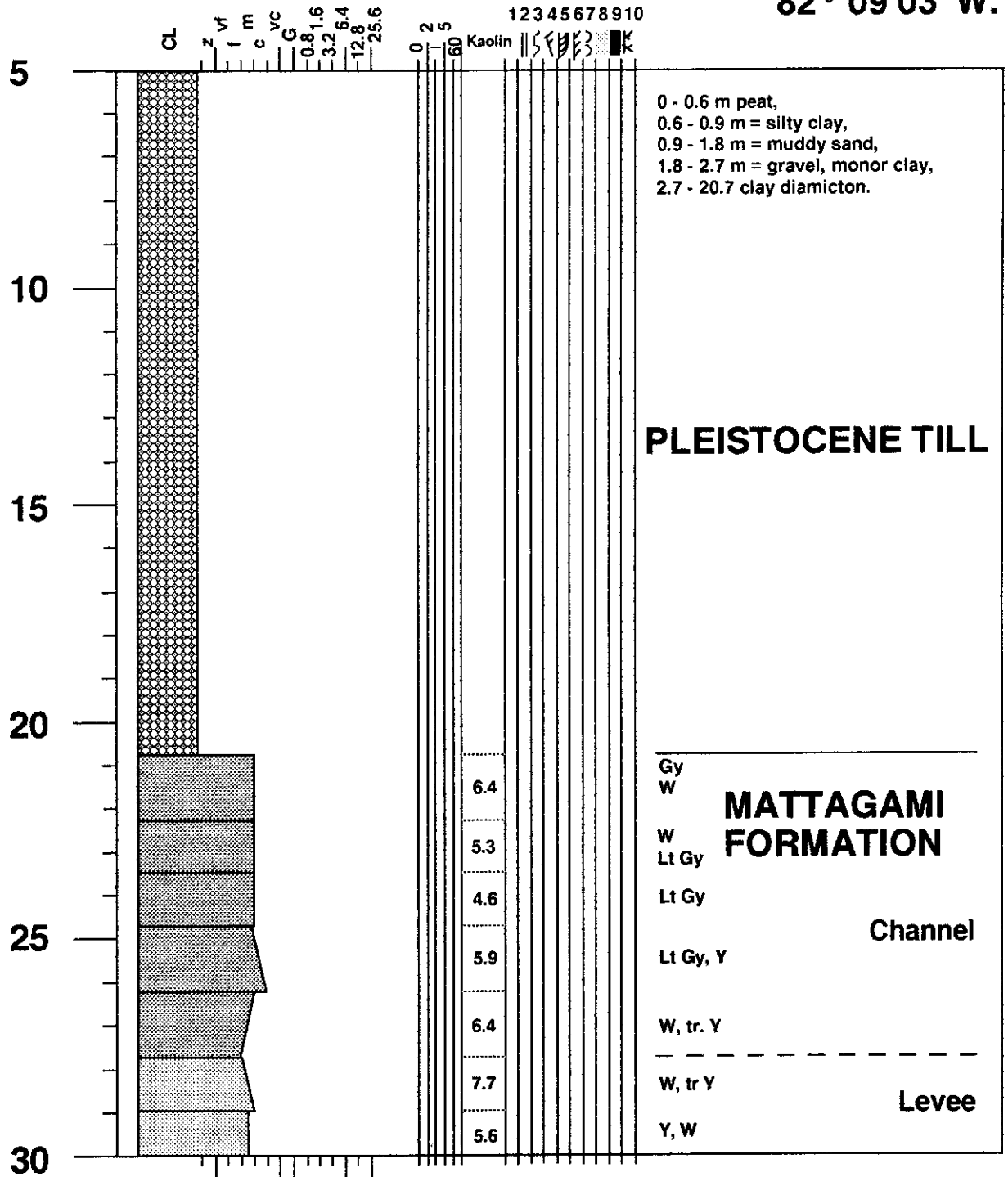
MRC hole 89 - 37, Kipling Twp.

50° 08'48"N,
82° 09'08"W.



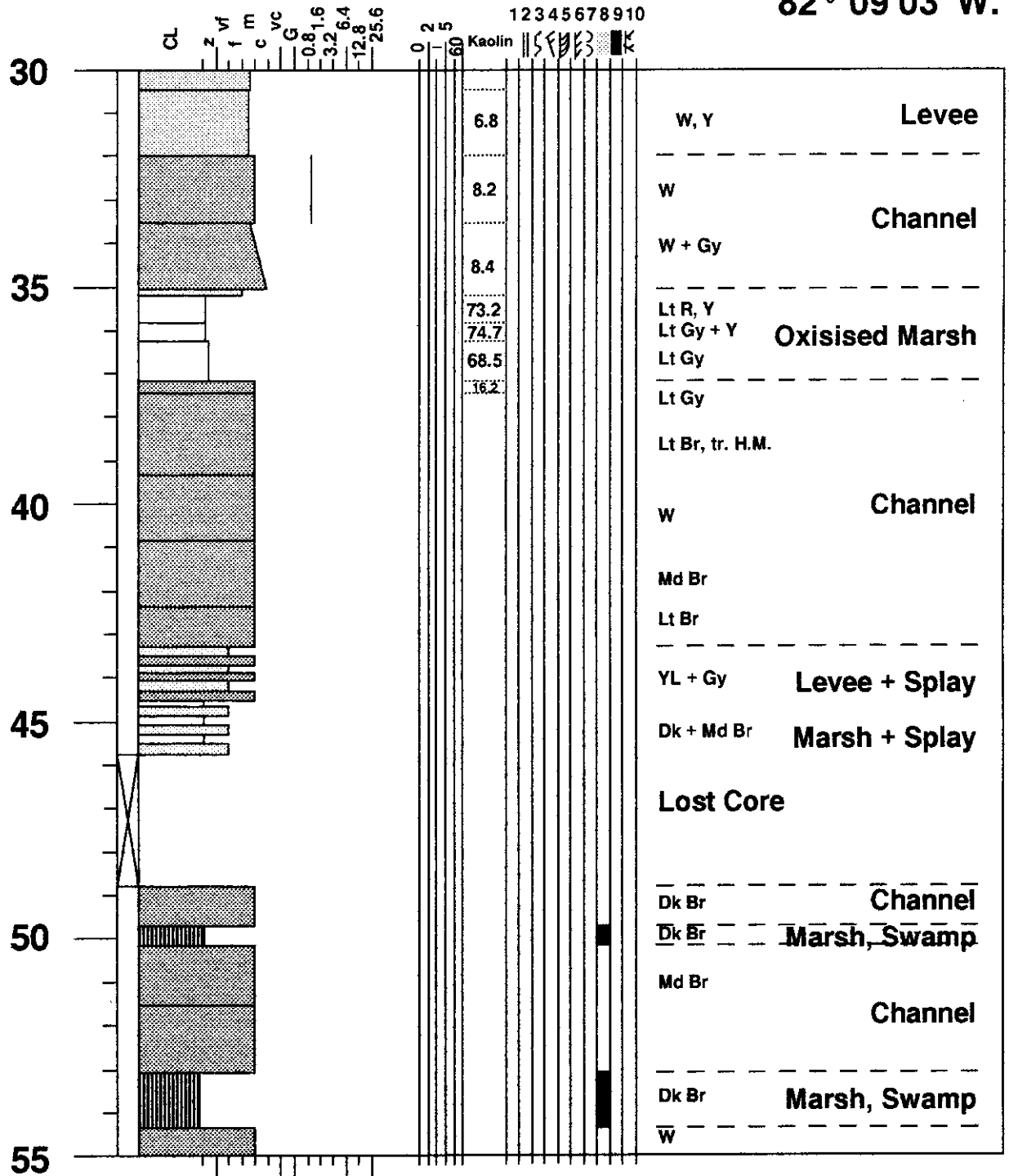
MRC hole 89 - 38, Kipling Twp.

50° 08'41"N,
82° 09'03"W.



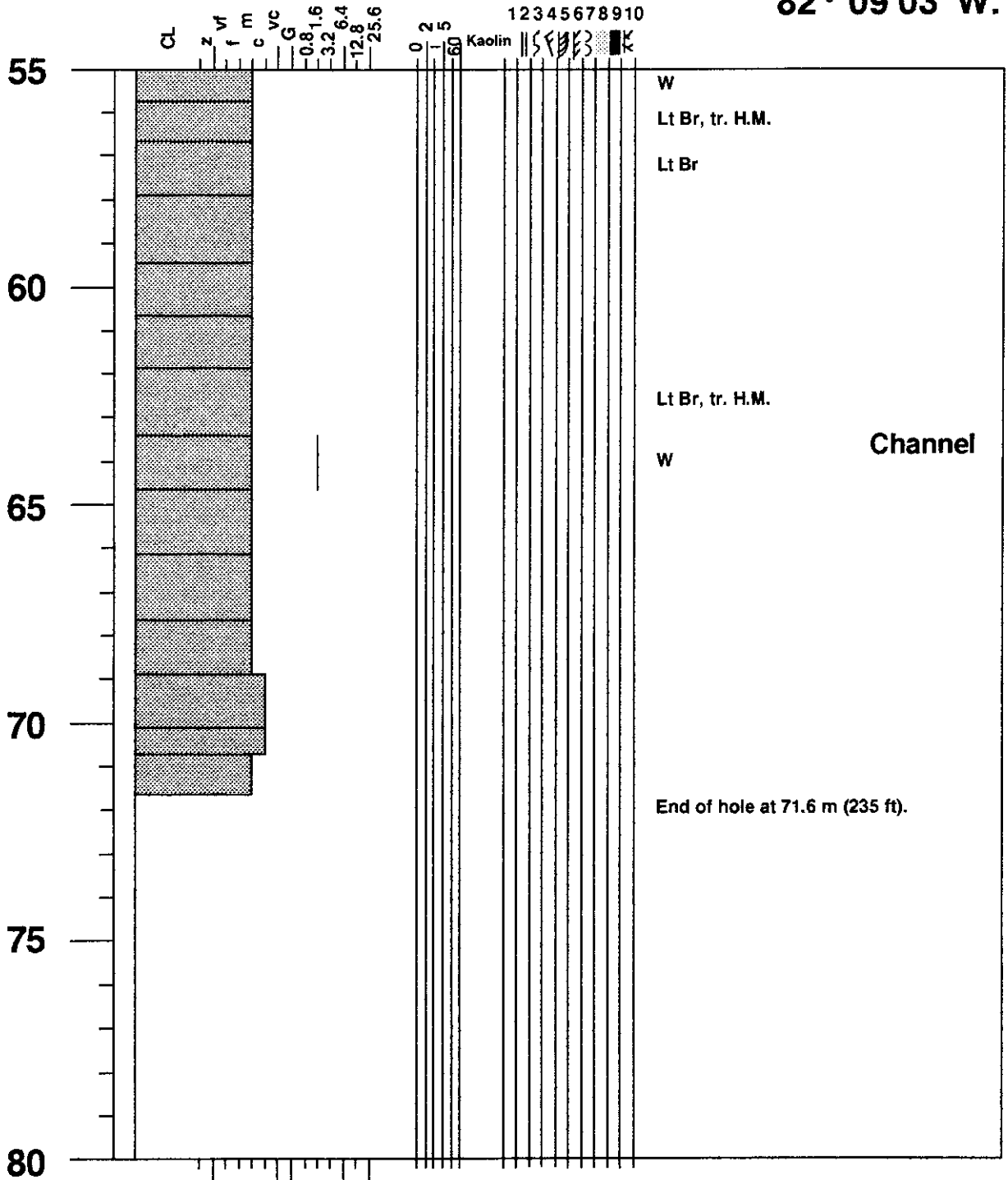
MRC hole 89 - 38, Kipling Twp.

50° 08'41"N,
82° 09'03"W.



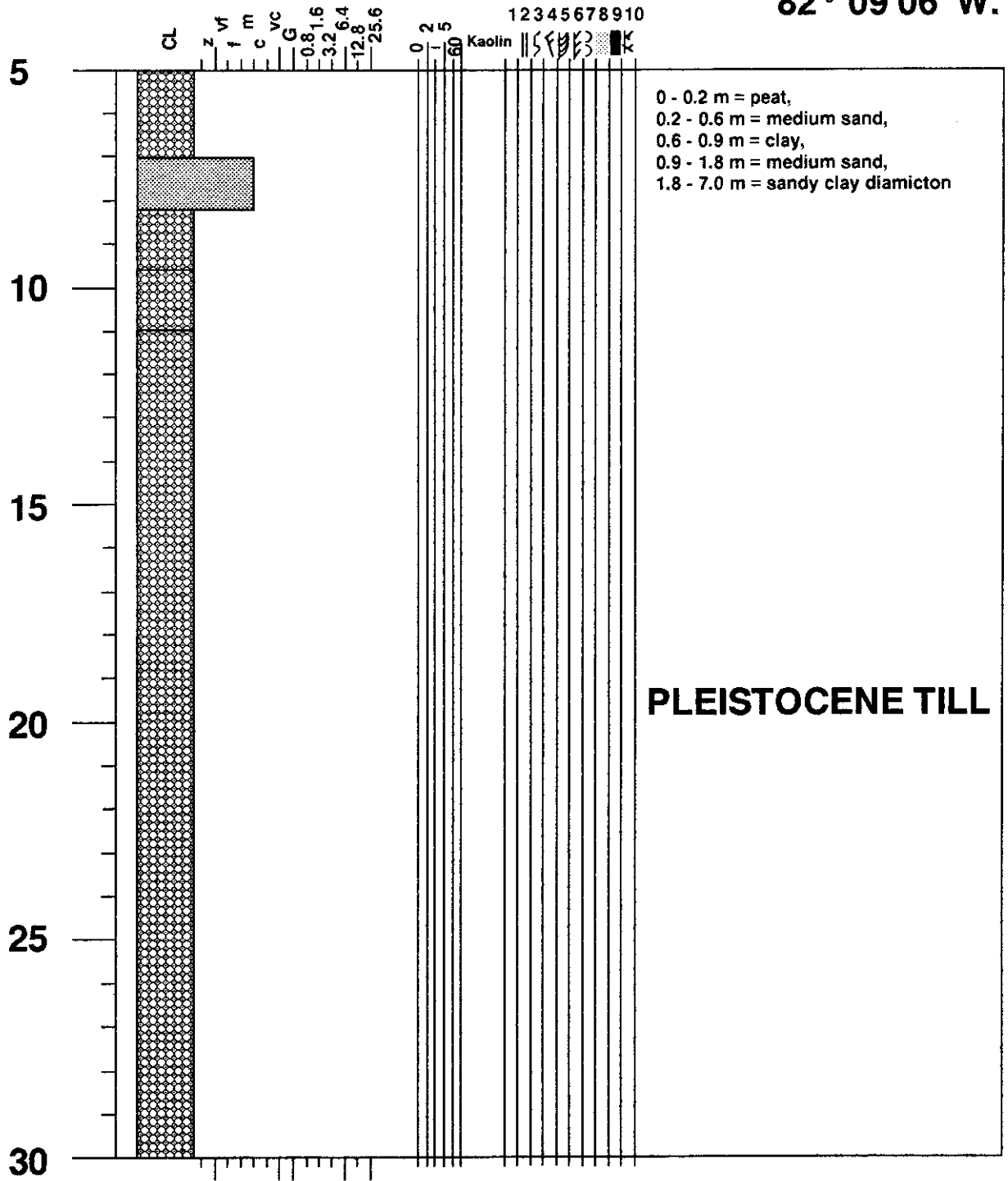
MRC hole 89 - 38, Kipling Twp.

50° 08'41"N,
82° 09'03"W.



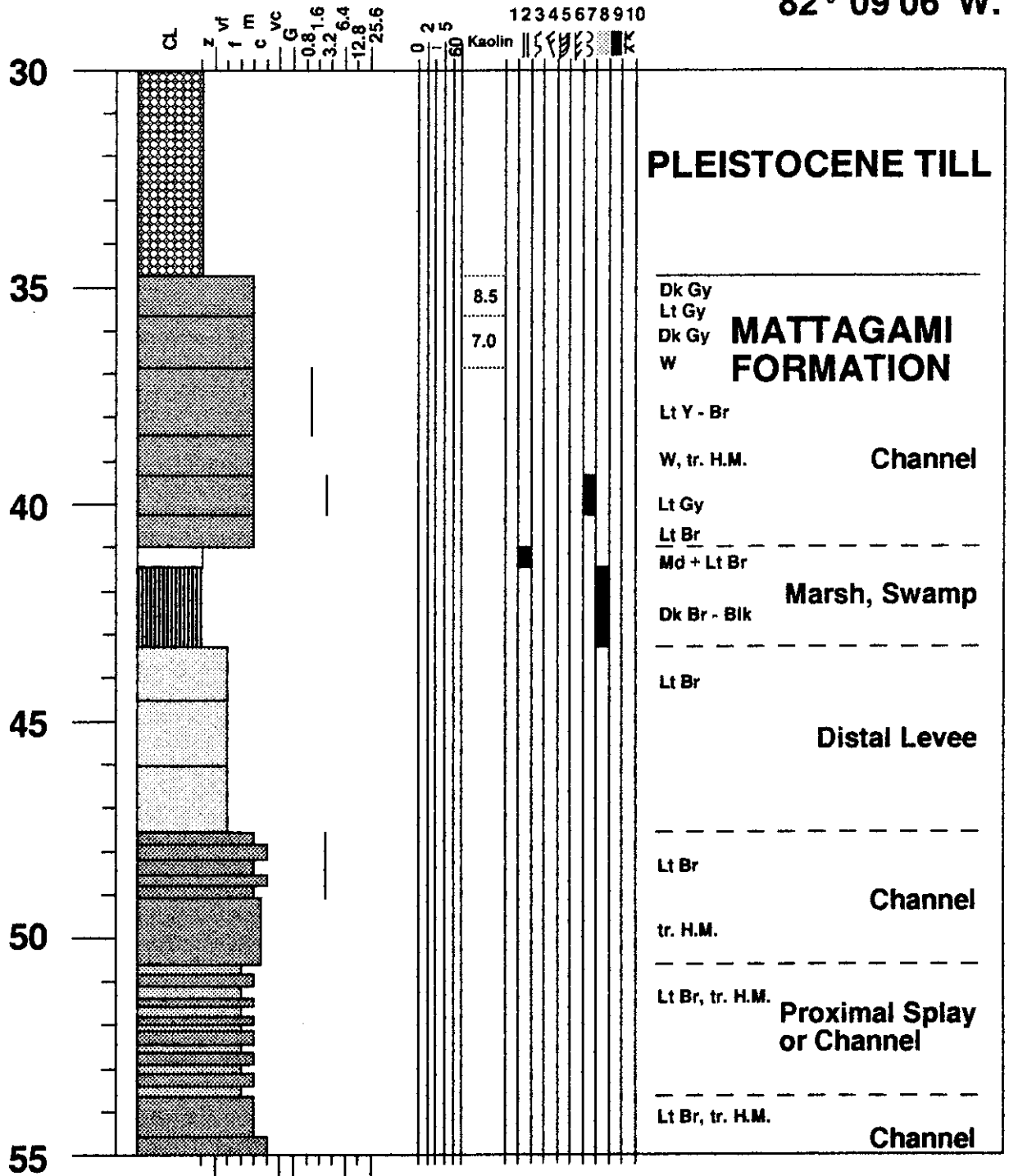
MRC hole 89 - 39, Kipling Twp.

50° 08'37"N,
82° 09'06"W.



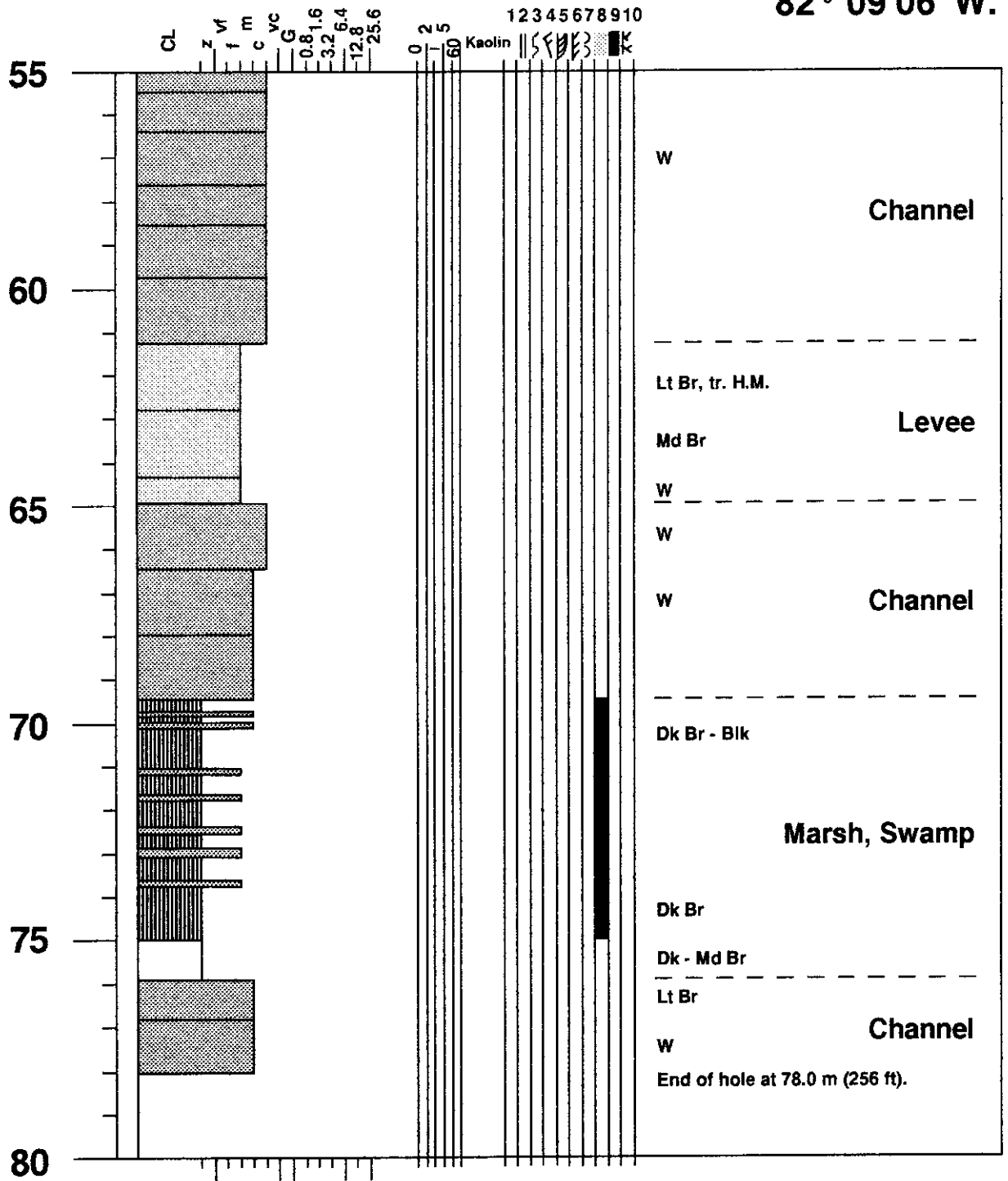
MRC hole 89 - 39, Kipling Twp.

50° 08'37"N,
82° 09'06"W.



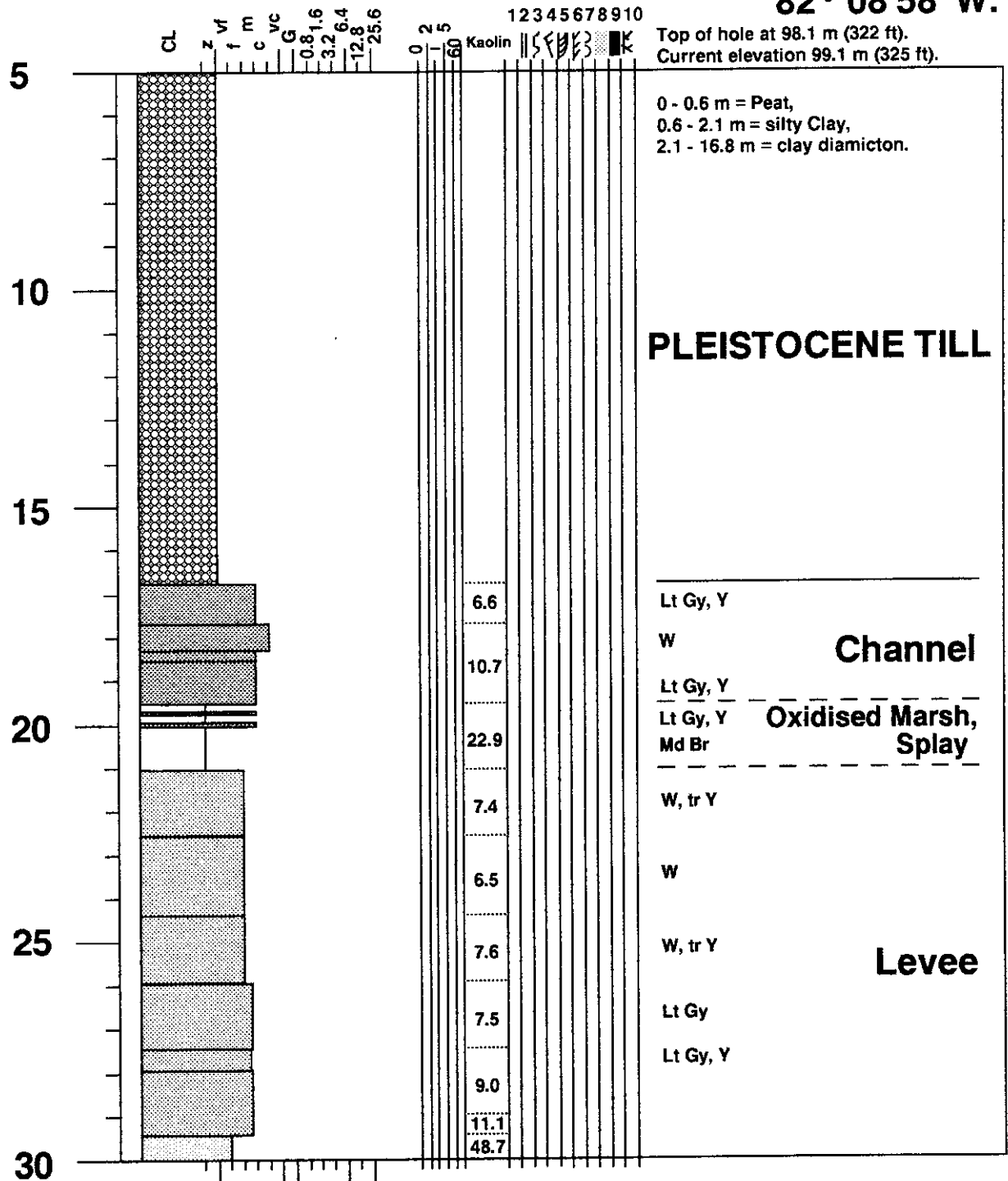
MRC hole 89 - 39, Kipling Twp.

50° 08'37"N,
82° 09'06"W.



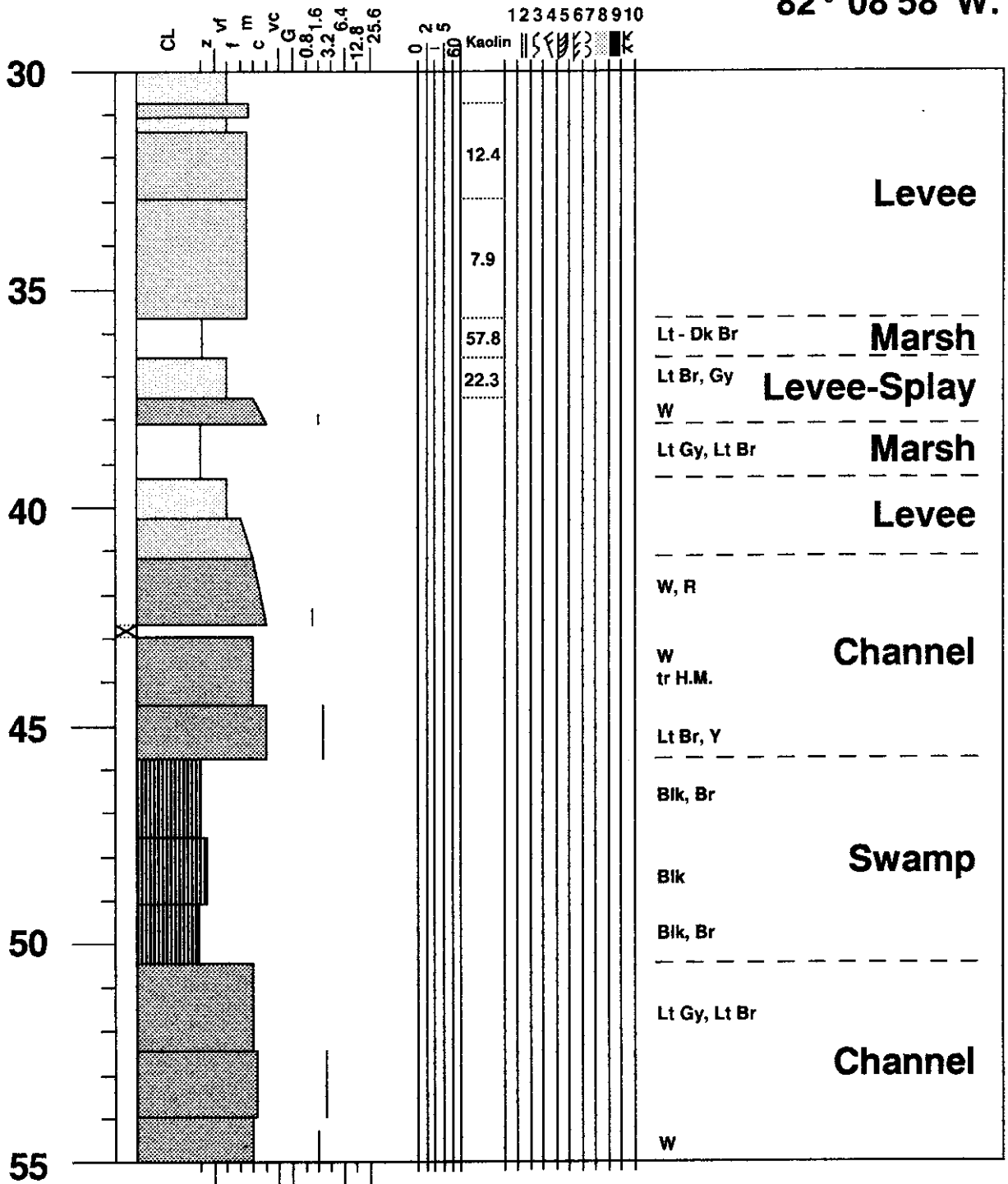
MRC hole 89 - 41, Kipling Twp.

50° 08'47"N,
82° 08'58"W.



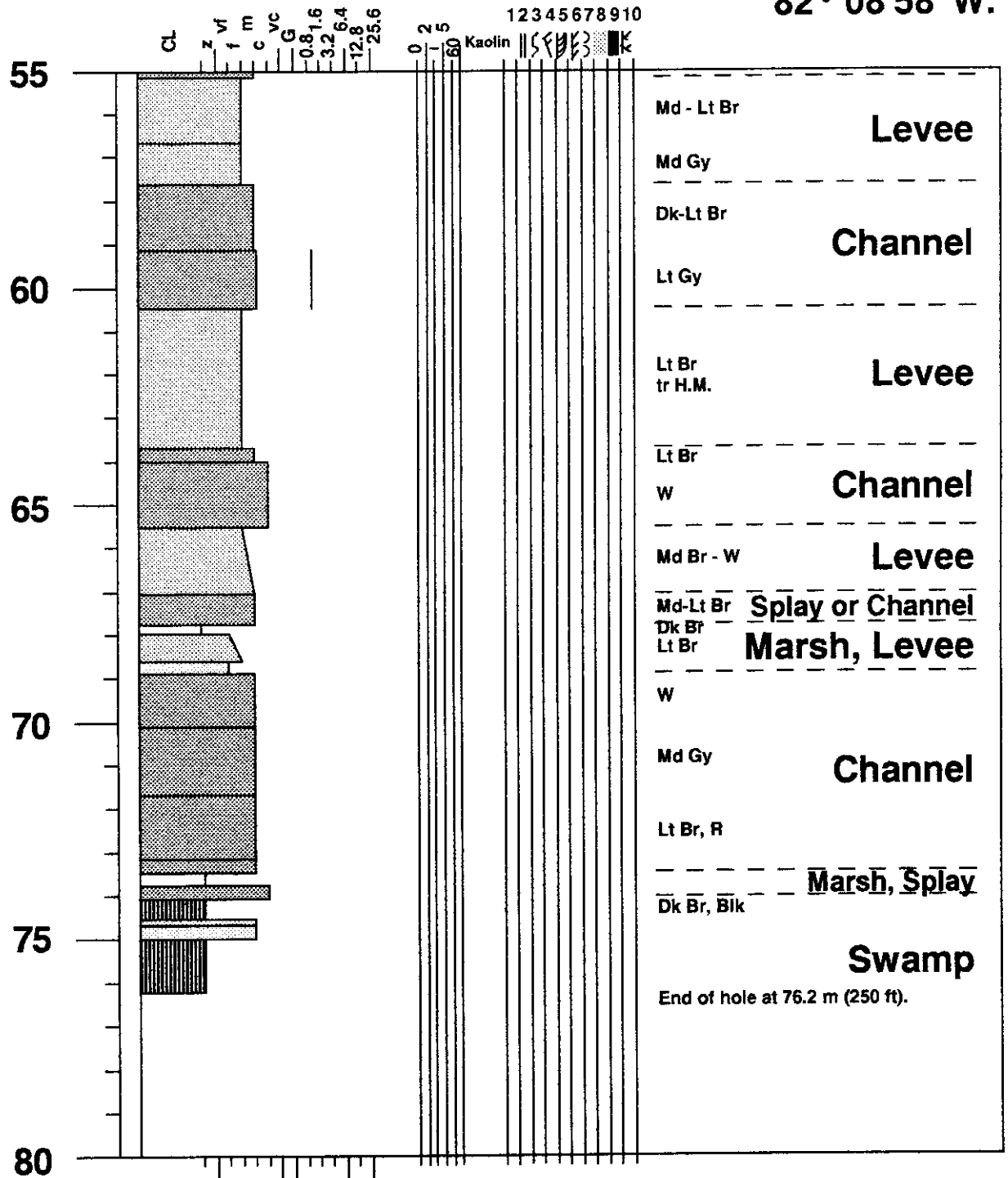
MRC hole 89 - 41, Kipling Twp.

50° 08'47"N,
82° 08'58"W.



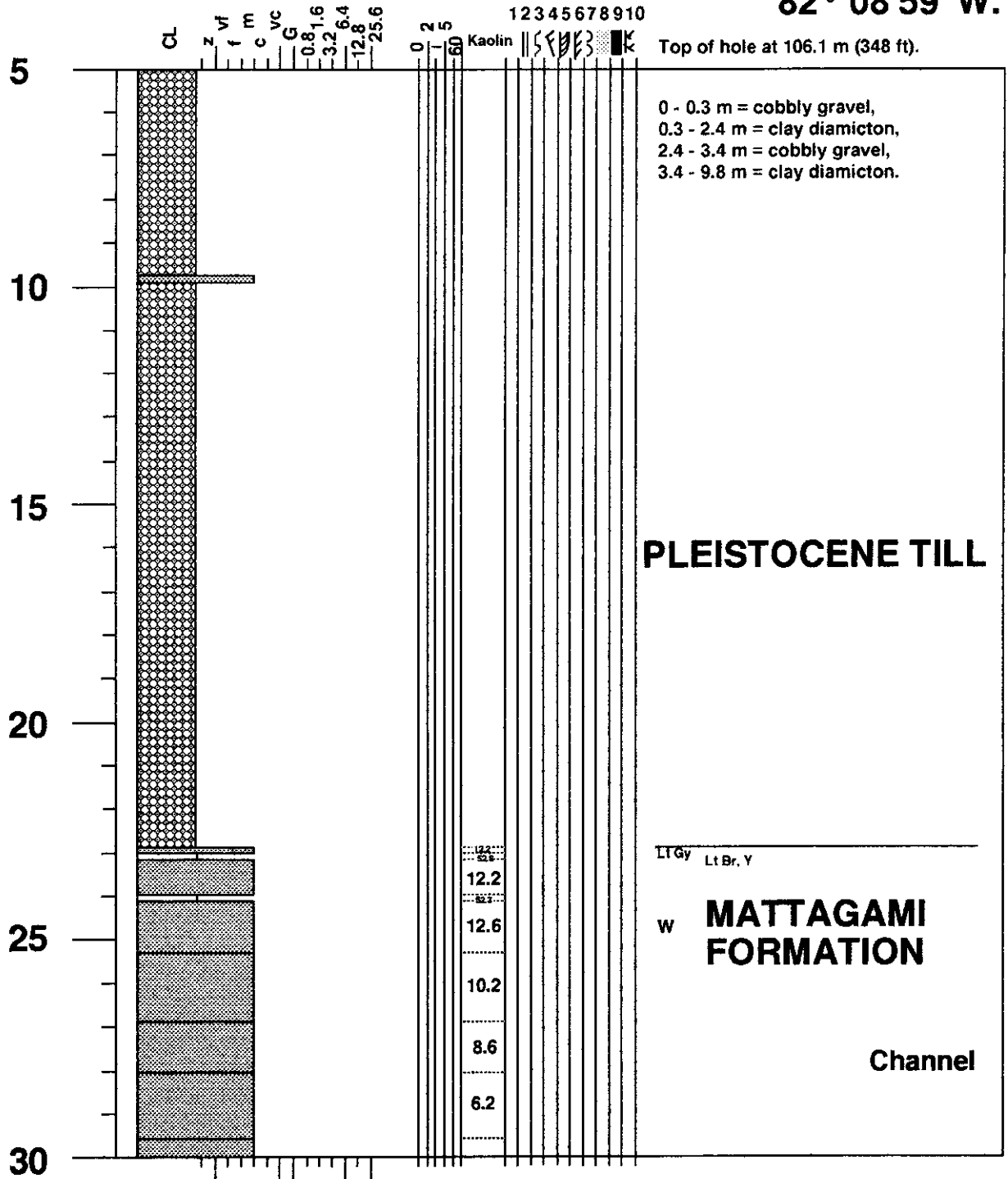
MRC hole 89 - 41, Kipling Twp.

50° 08'47"N,
82° 08'58"W.



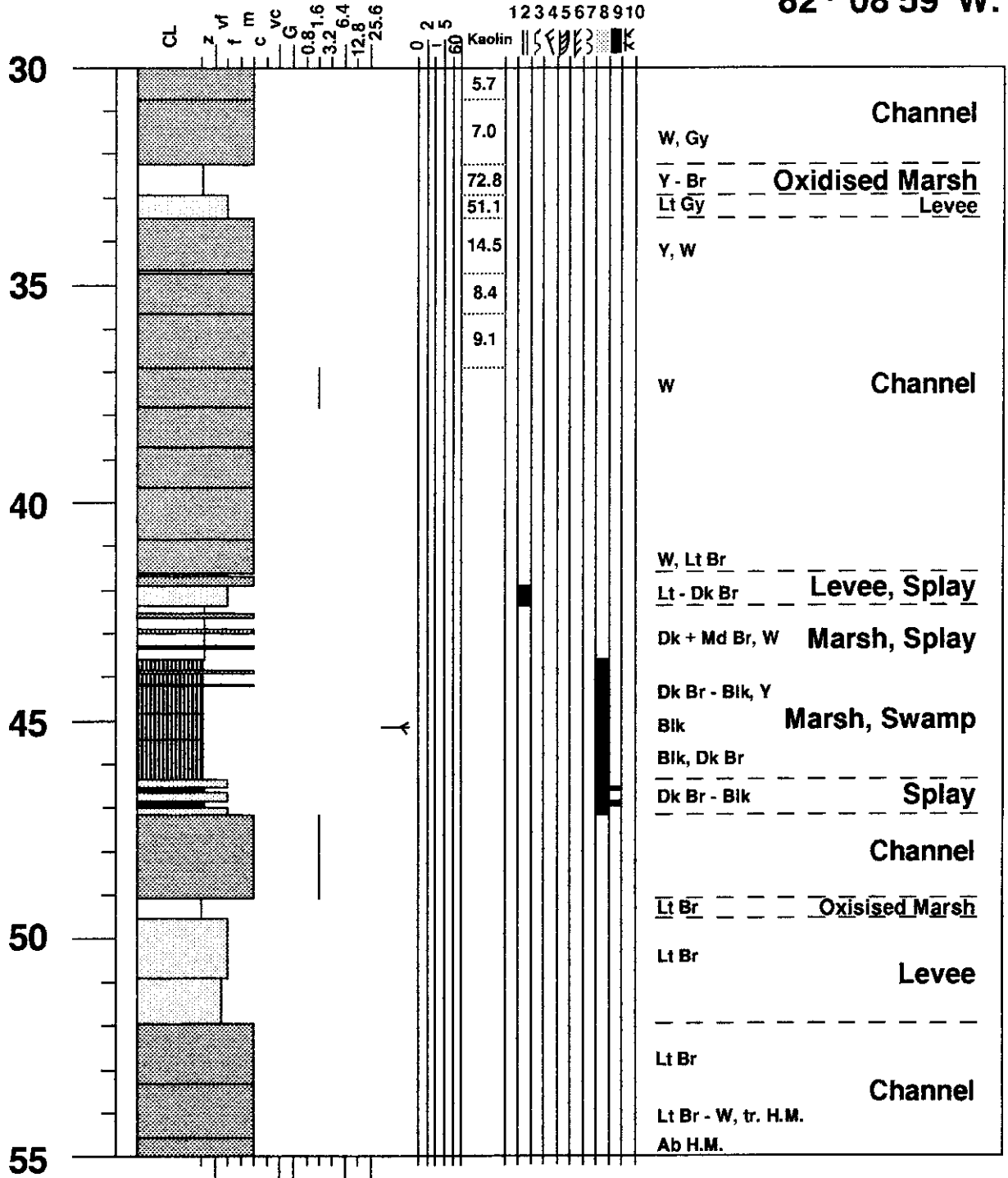
MRC hole 89 - 42, Kipling Twp.

**50° 08'40"N,
82° 08'59"W.**



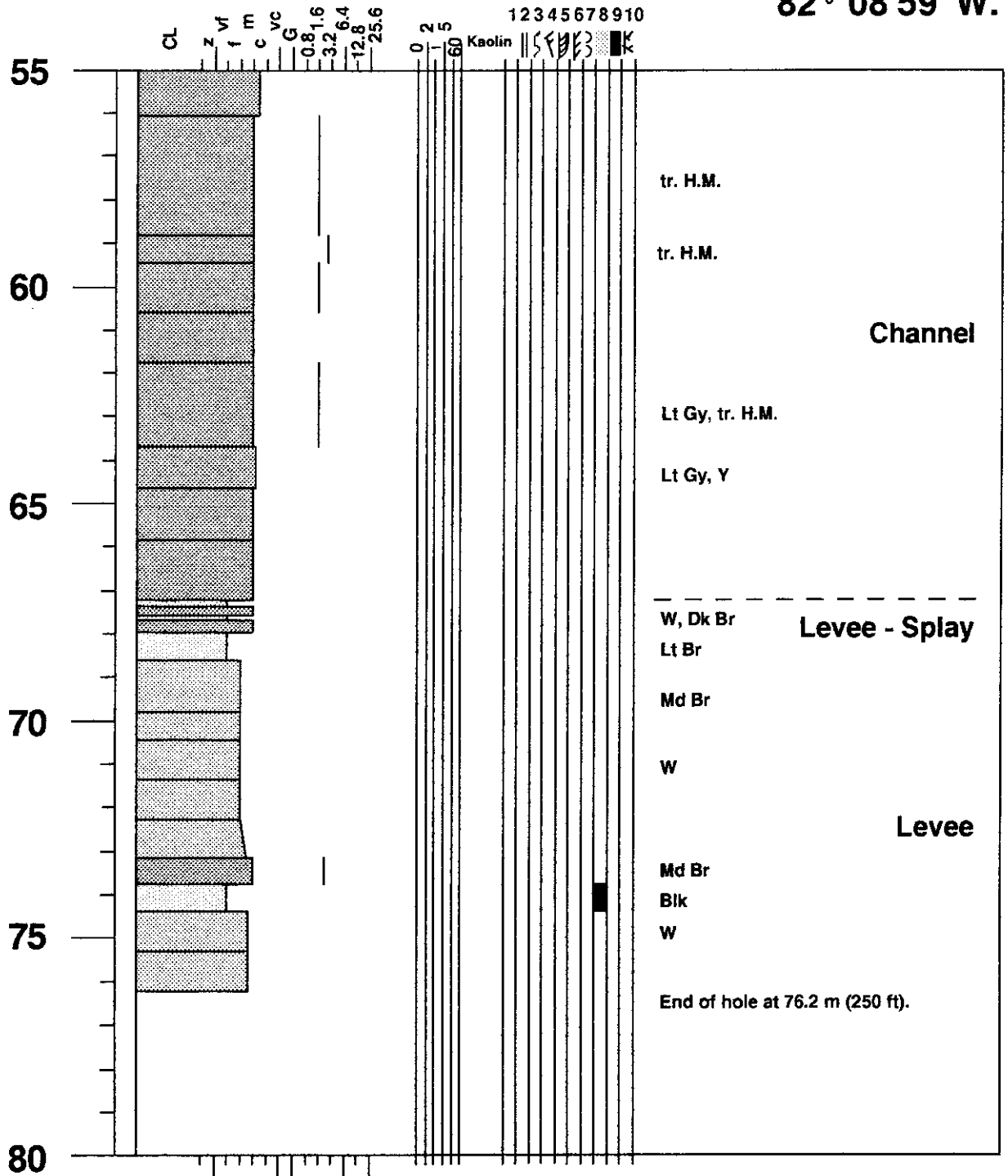
MRC hole 89 - 42, Kipling Twp.

50° 08'40"N,
82° 08'59"W.



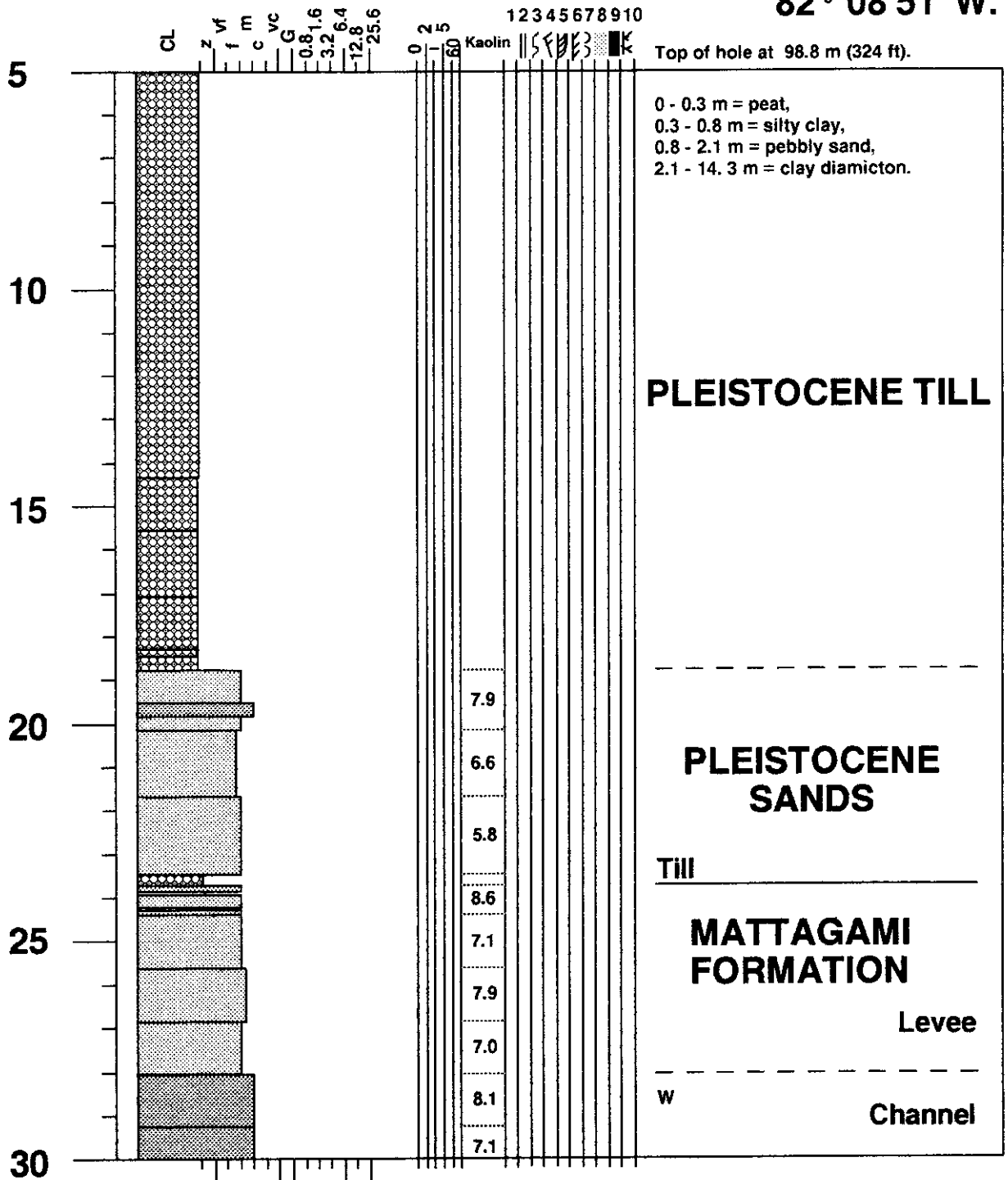
MRC hole 89 - 42, Kipling Twp.

50° 08'40"N,
82° 08'59"W.



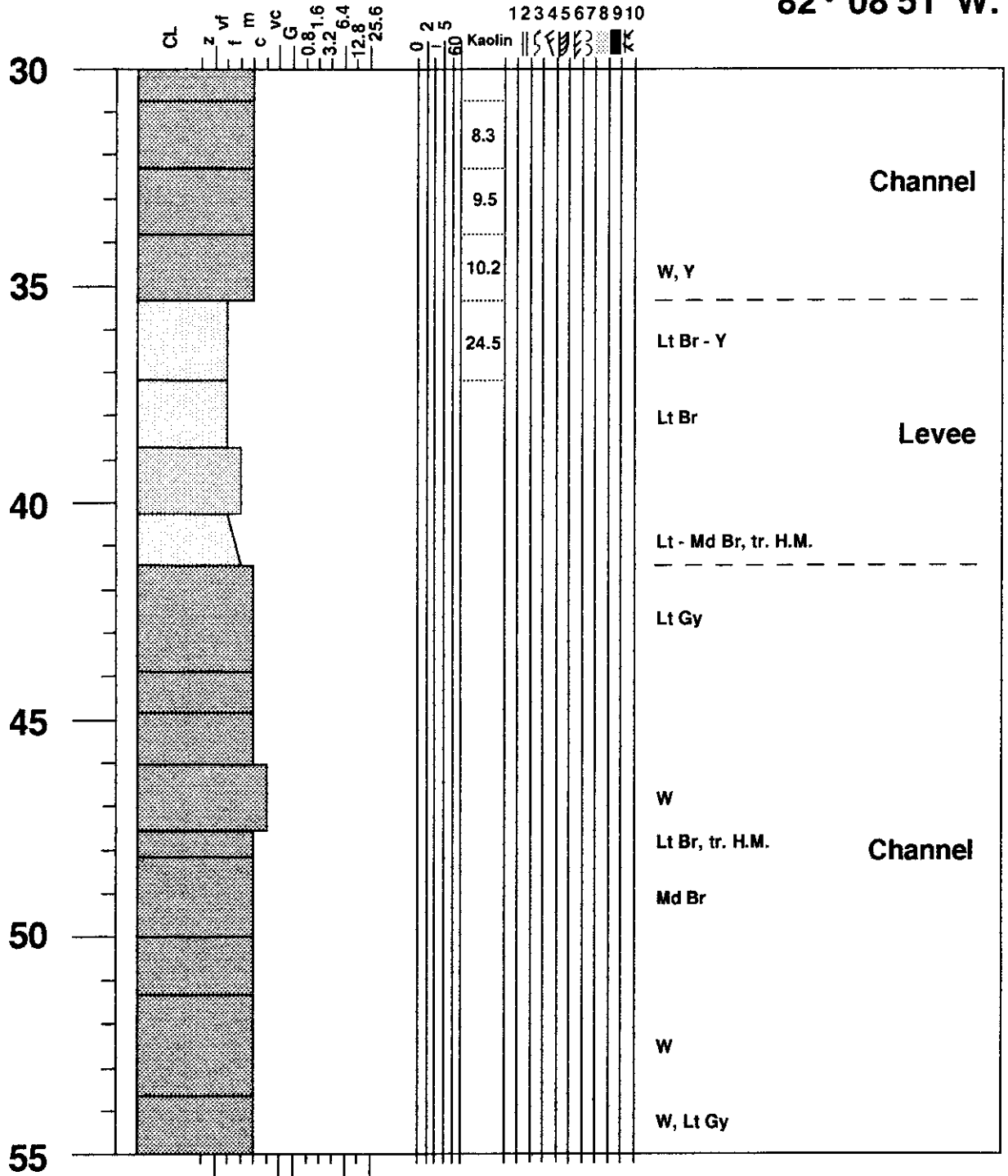
MRC hole 89 - 44, Kipling Twp.

50° 08'44"N,
82° 08'51"W.



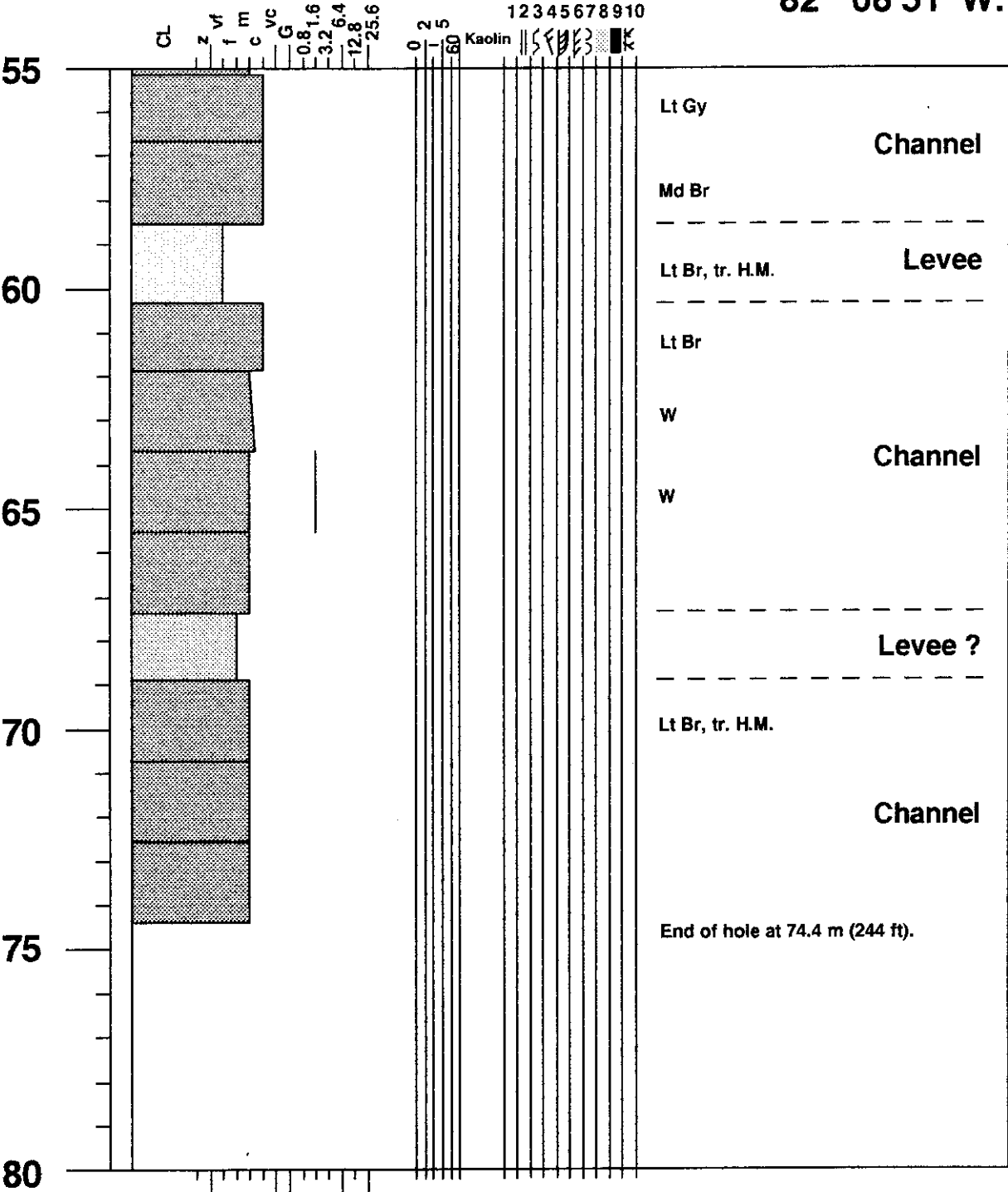
MRC hole 89 - 44, Kipling Twp.

50° 08'44"N,
82° 08'51"W.



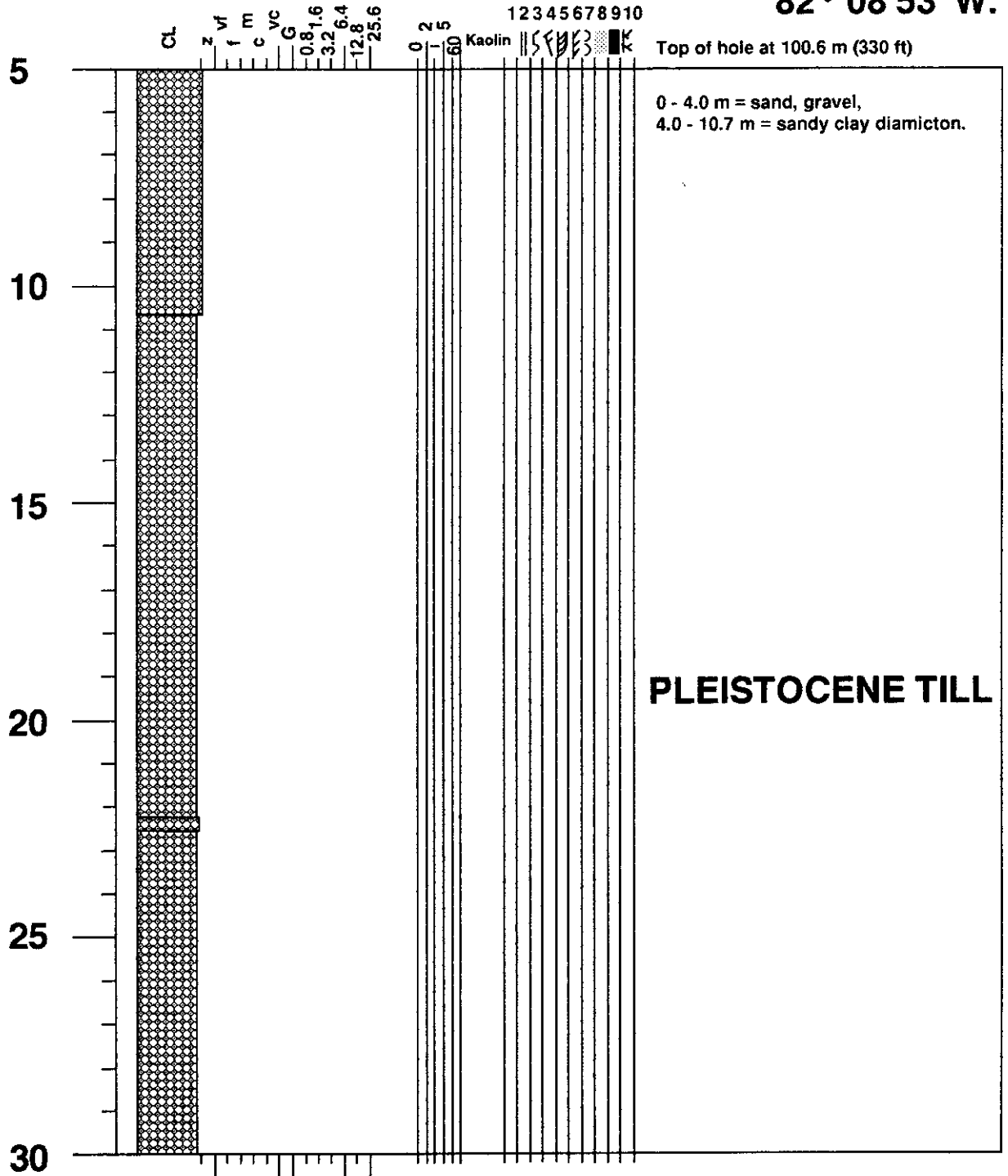
MRC hole 89 - 44, Kipling Twp.

50° 08'44"N,
82° 08'51"W.



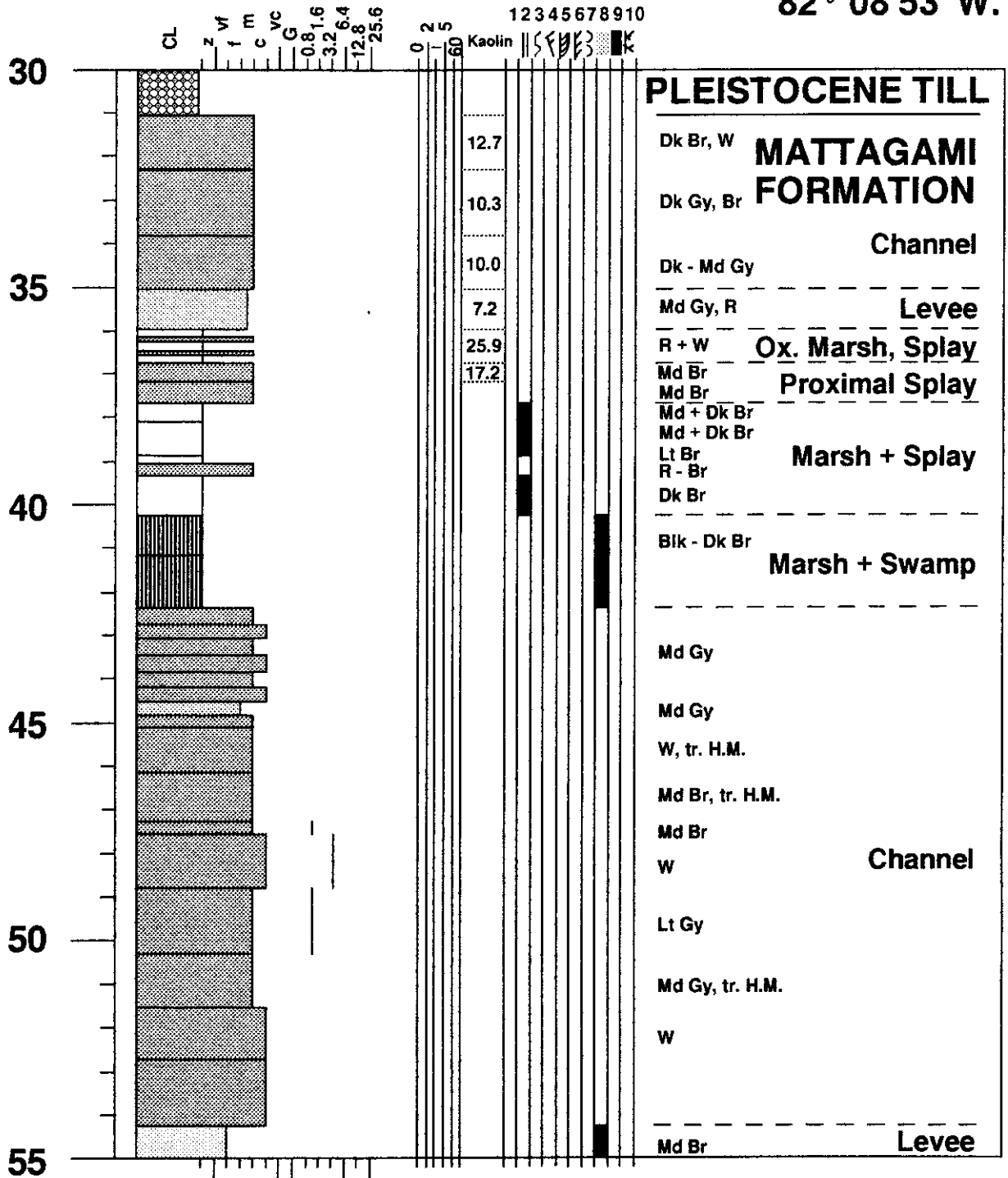
MRC hole 89 - 45, Kipling Twp.

50° 08'36"N,
82° 08'53"W.



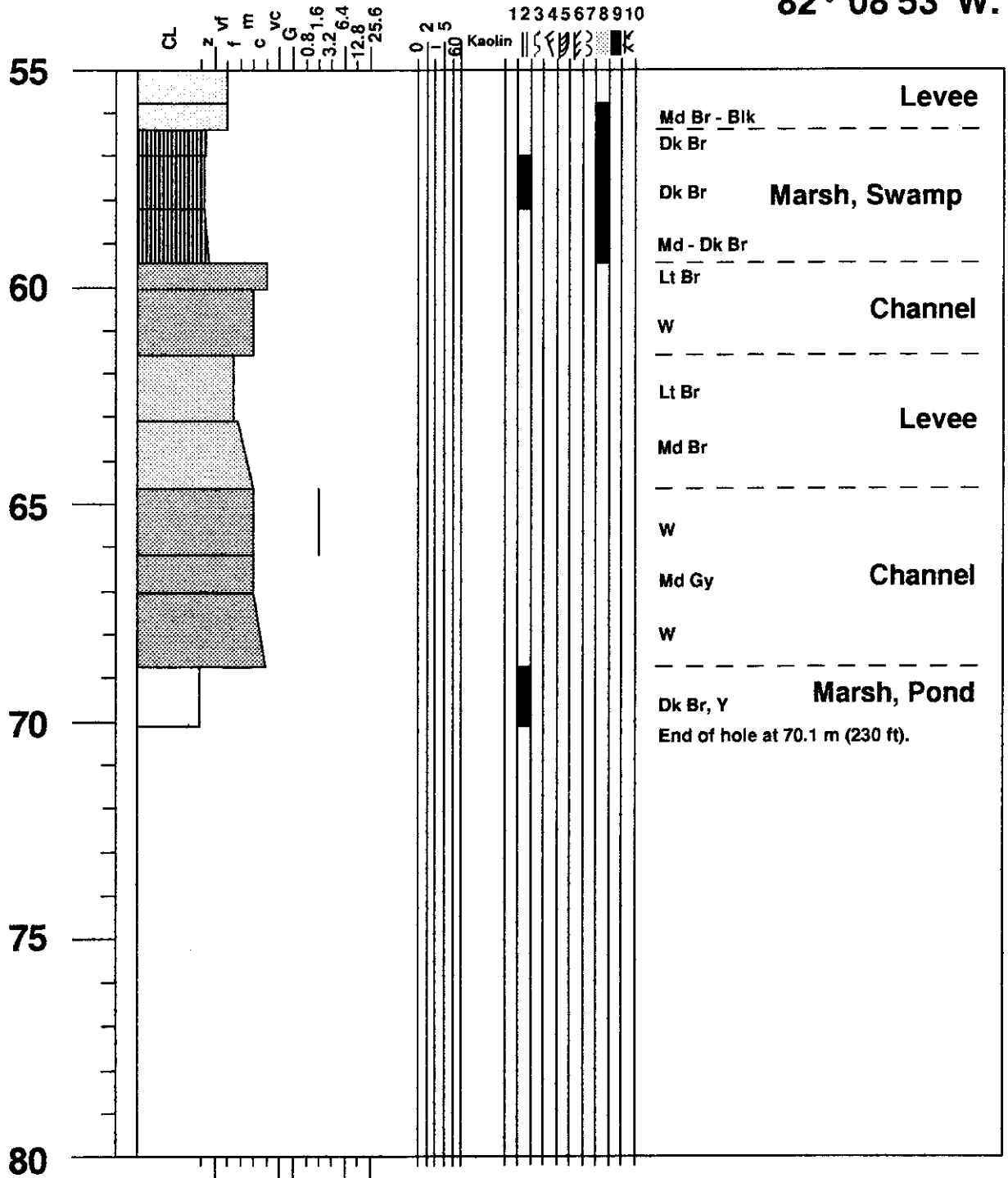
MRC hole 89 - 45, Kipling Twp.

50° 08'36"N,
82° 08'53"W.



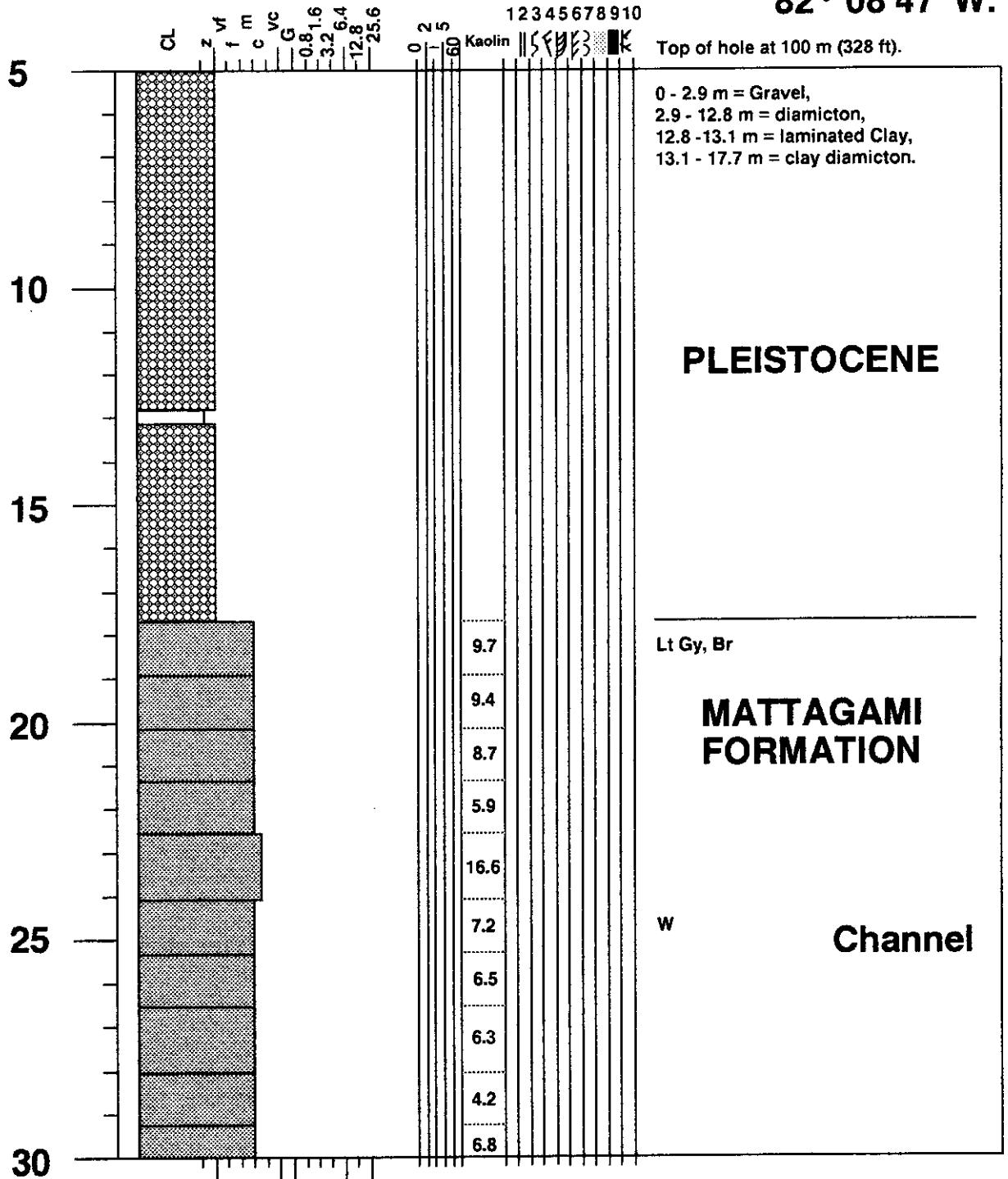
MRC hole 89 - 45, Kipling Twp.

50° 08'36"N,
82° 08'53"W.



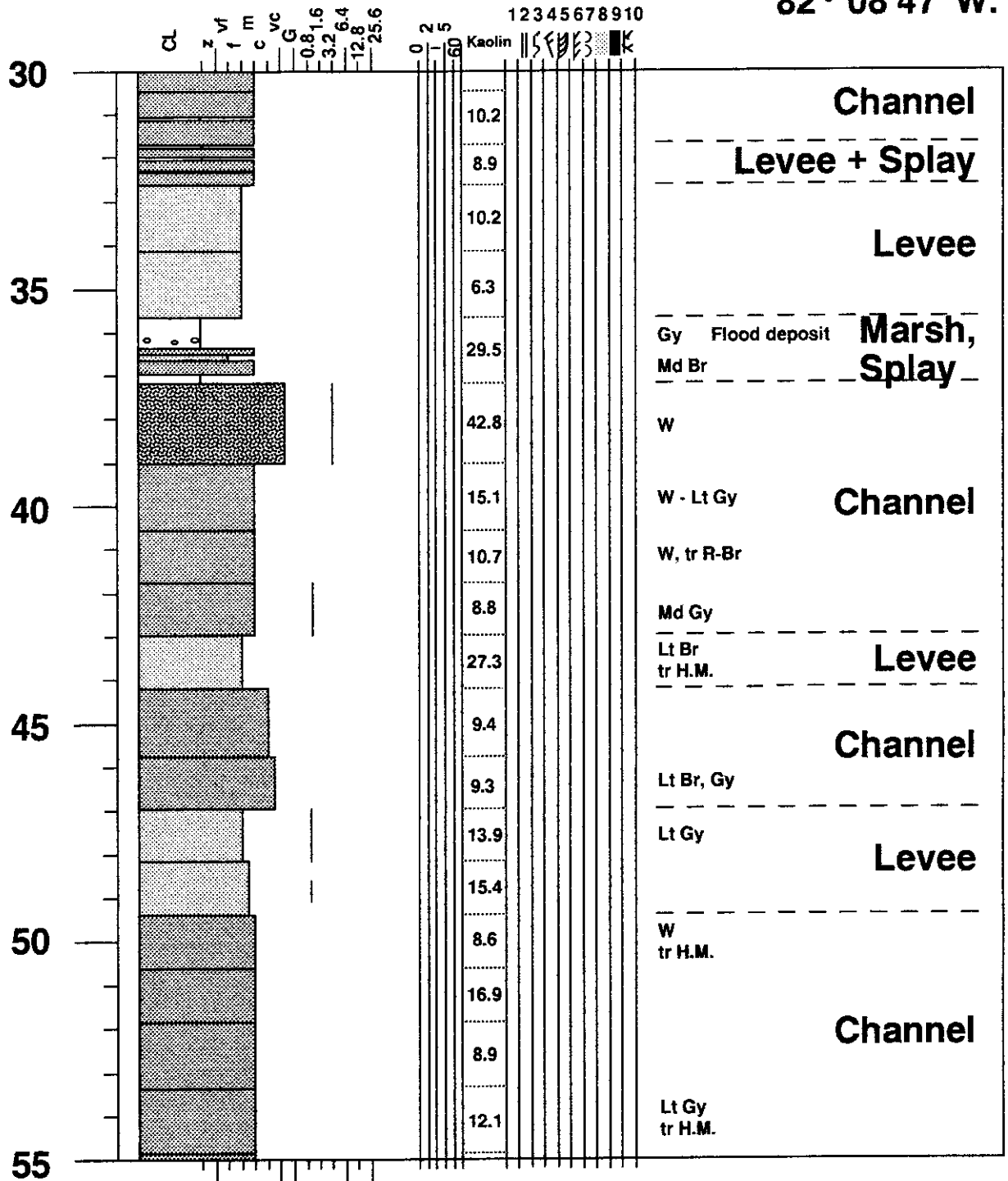
MRC hole 89 - 48, Kipling Twp.

50° 08'47"N,
82° 08'47"W.



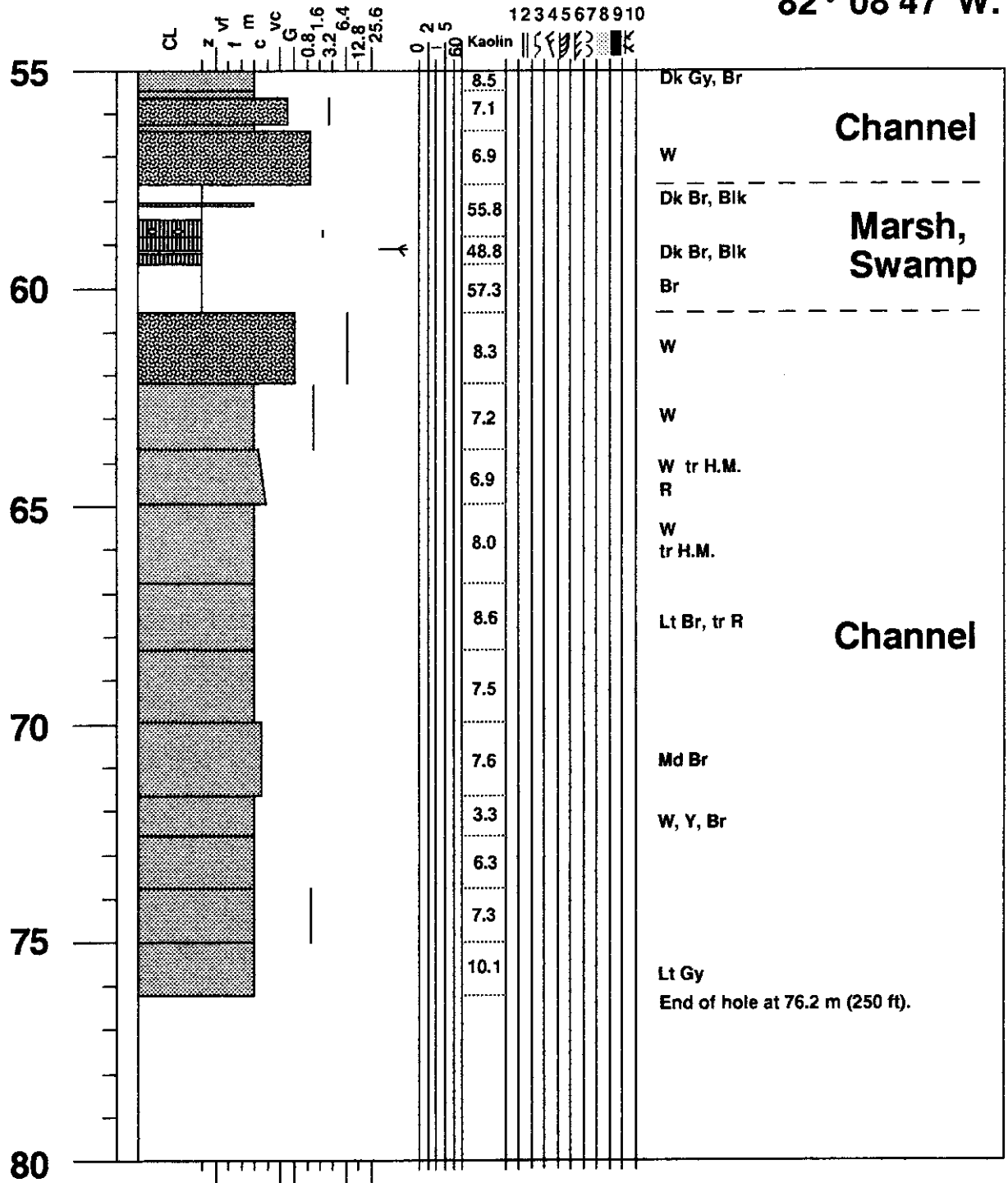
MRC hole 89 - 48, Kipling Twp.

50° 08'47"N,
82° 08'47"W.



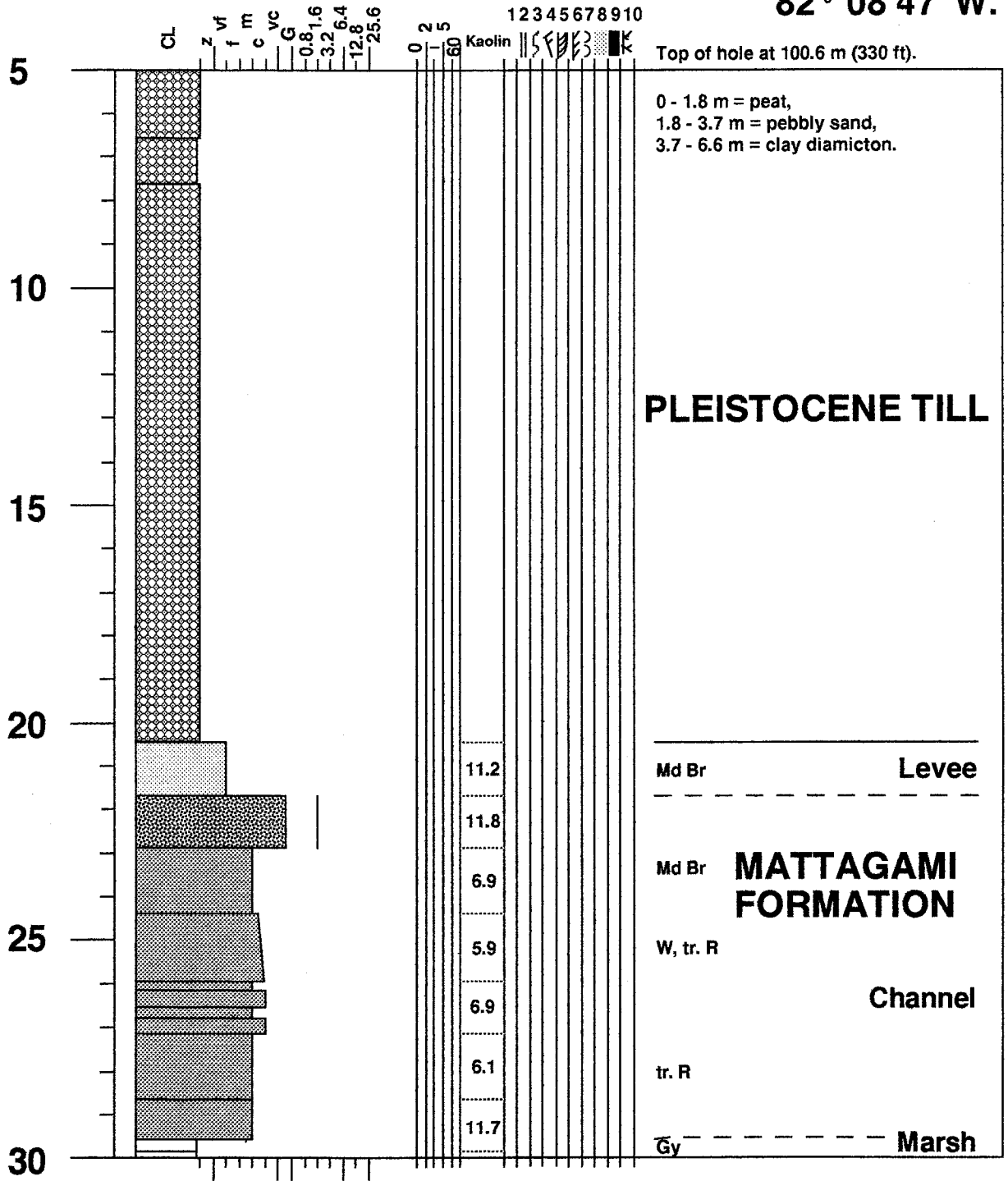
MRC hole 89 - 48, Kipling Twp.

50° 08'47"N,
82° 08'47"W.



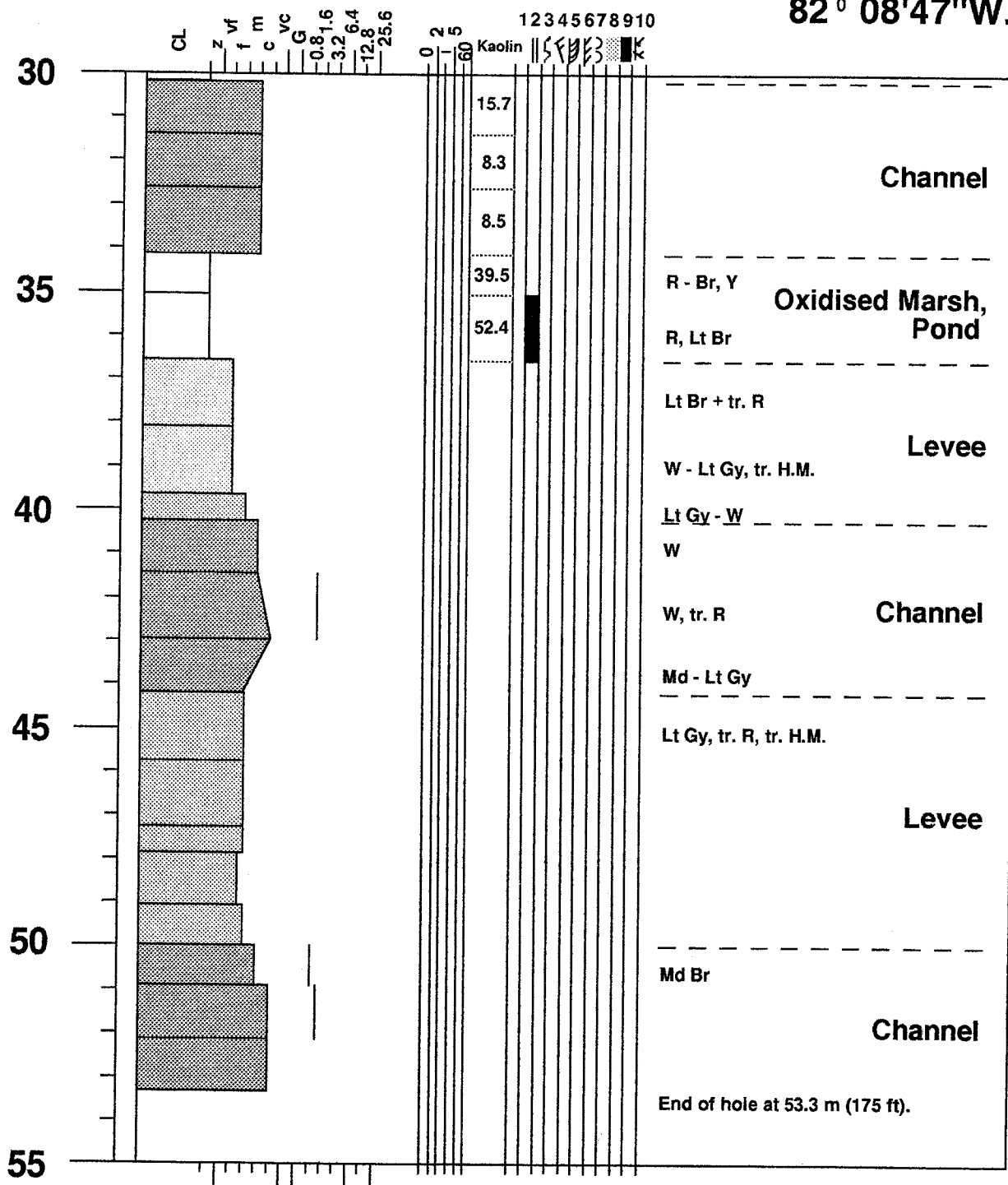
MRC hole 89 - 49, Kipling Twp.

50° 08'42"N,
82° 08'47"W.



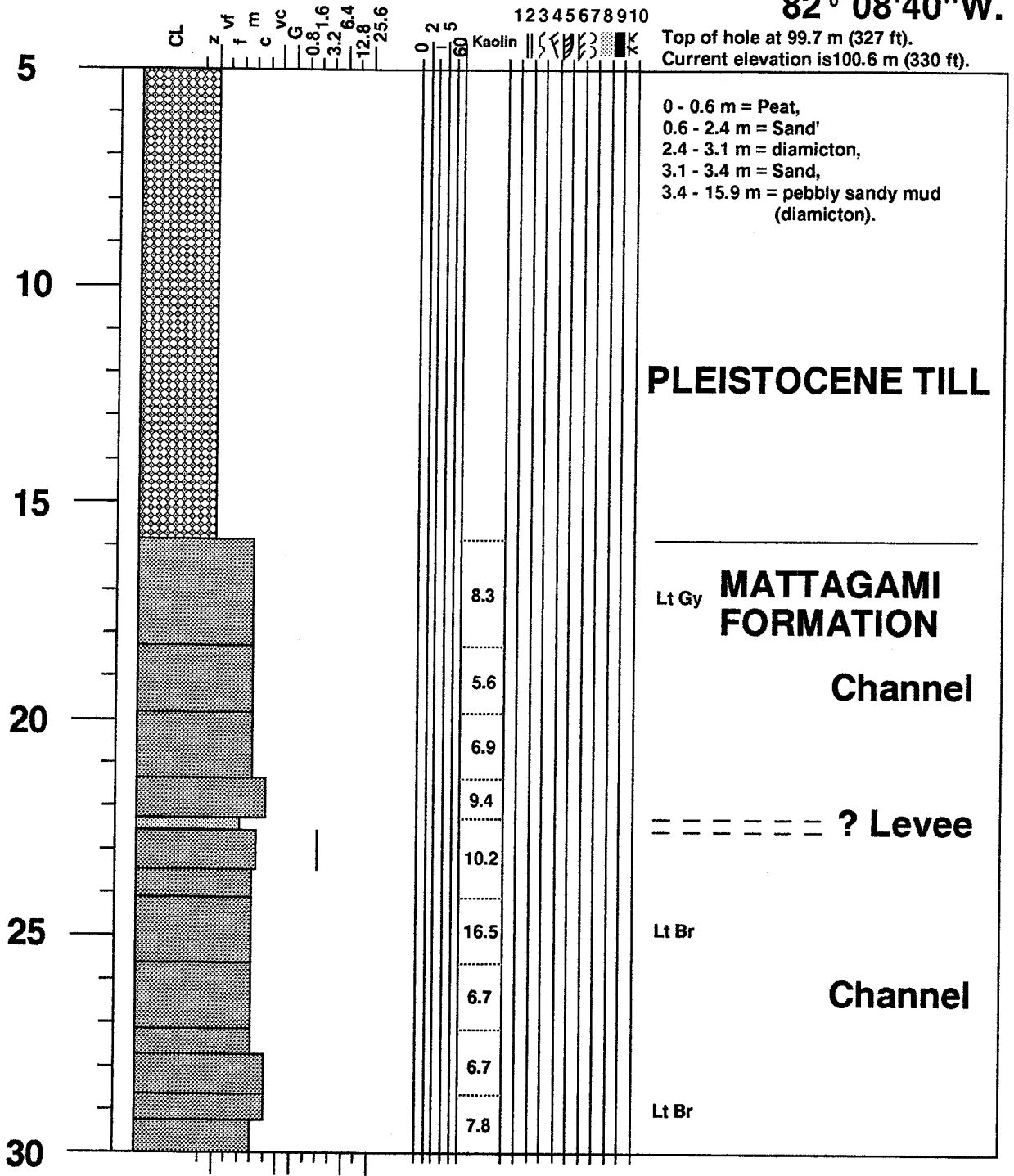
MRC hole 89 - 49, Kipling Twp.

50° 08'42"N,
82° 08'47"W.



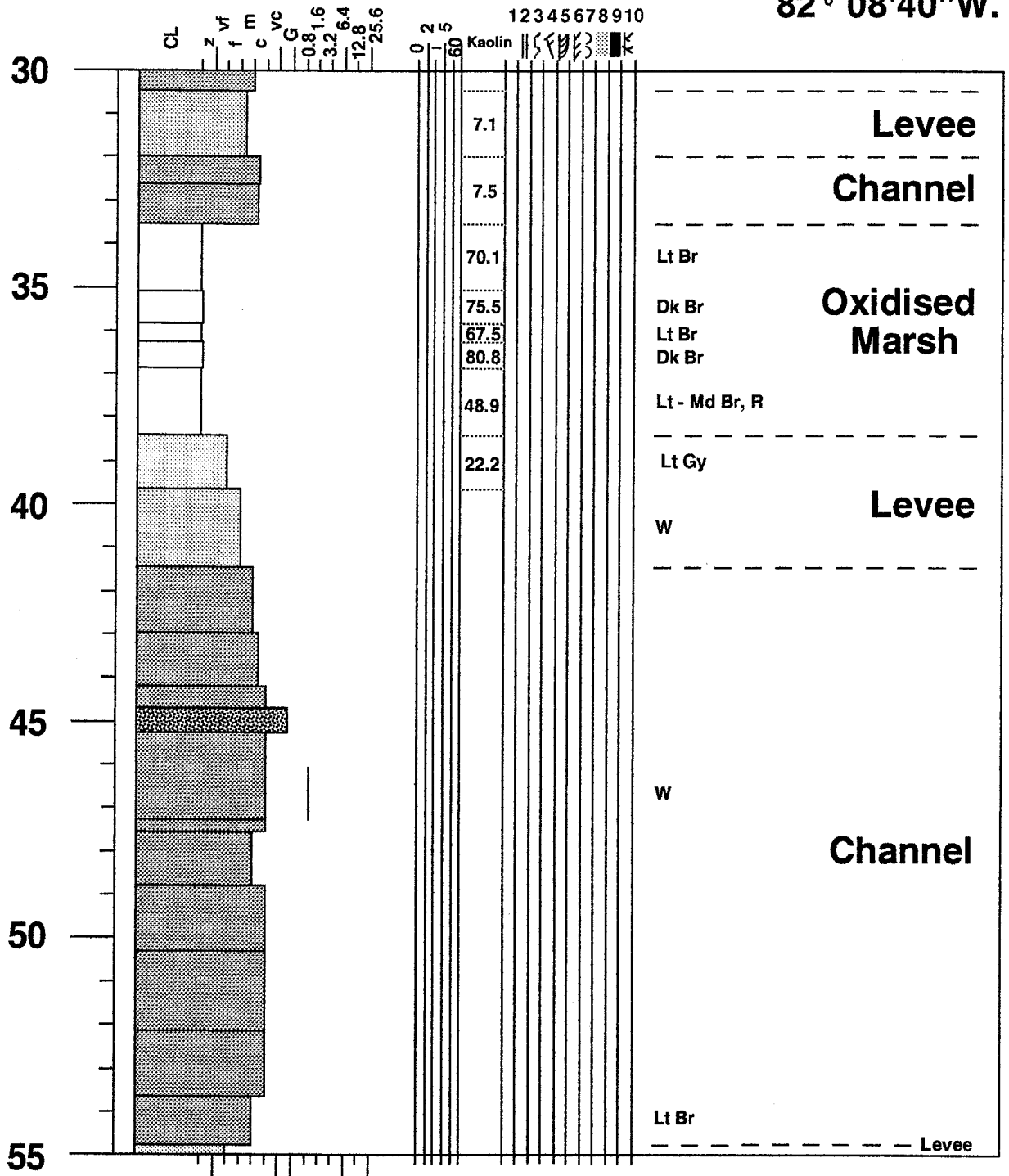
MRC hole 89 - 50, Kipling Twp.

50° 08'50"N,
82° 08'40"W.



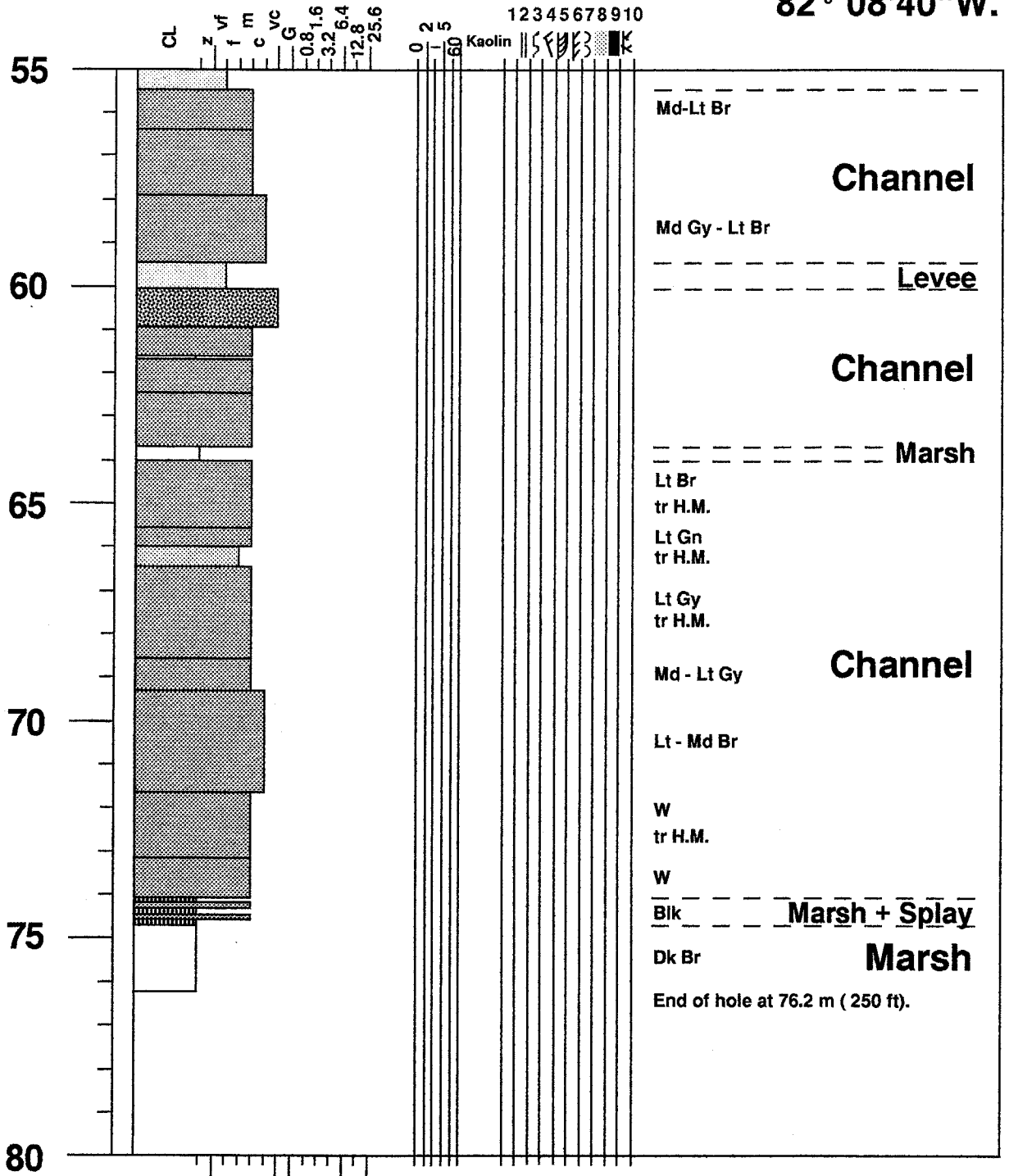
MRC hole 89 - 50, Kipling Twp.

50° 08'50"N,
82° 08'40"W.



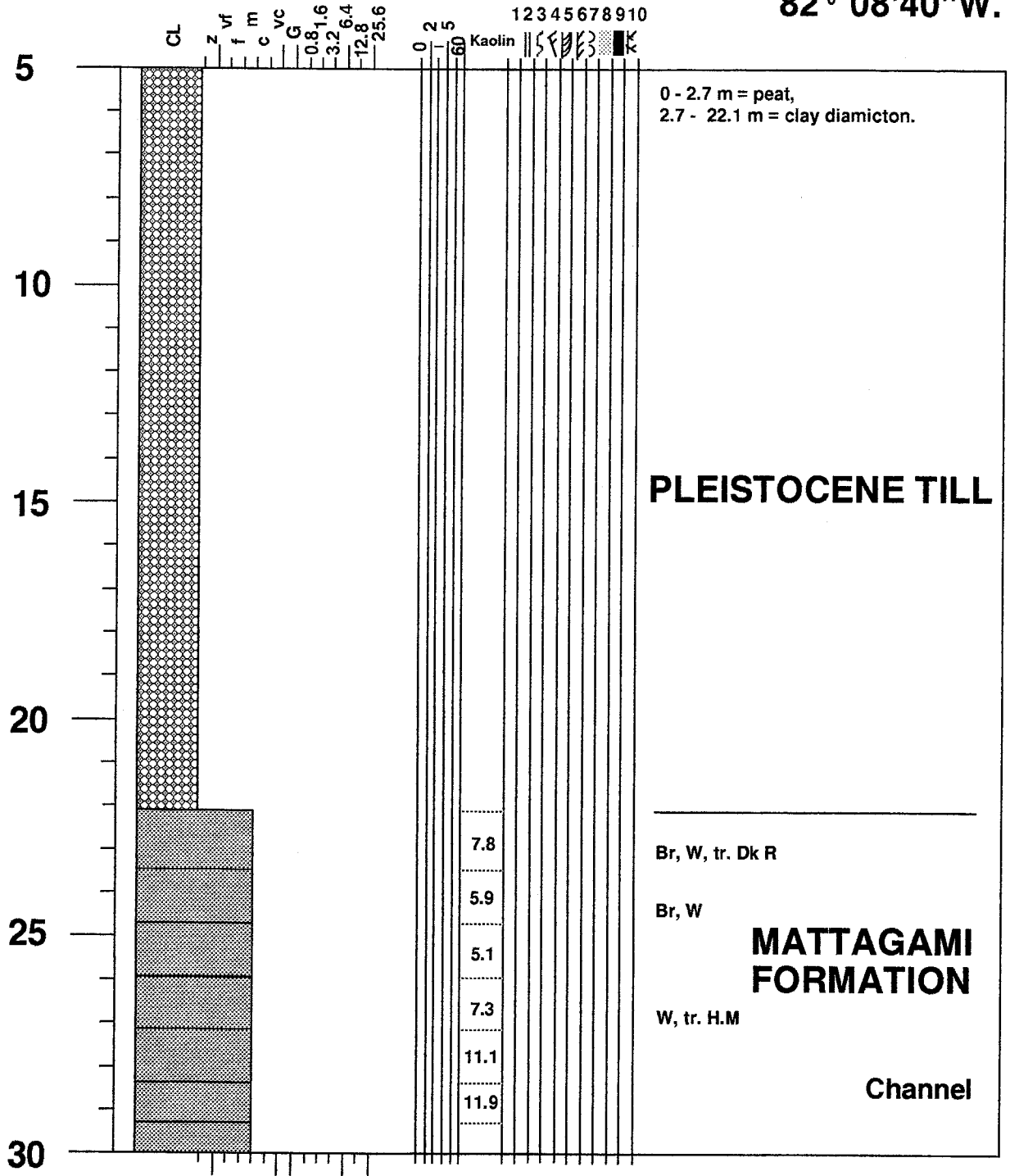
MRC hole 89 - 50, Kipling Twp.

50° 08'50"N,
82° 08'40"W.



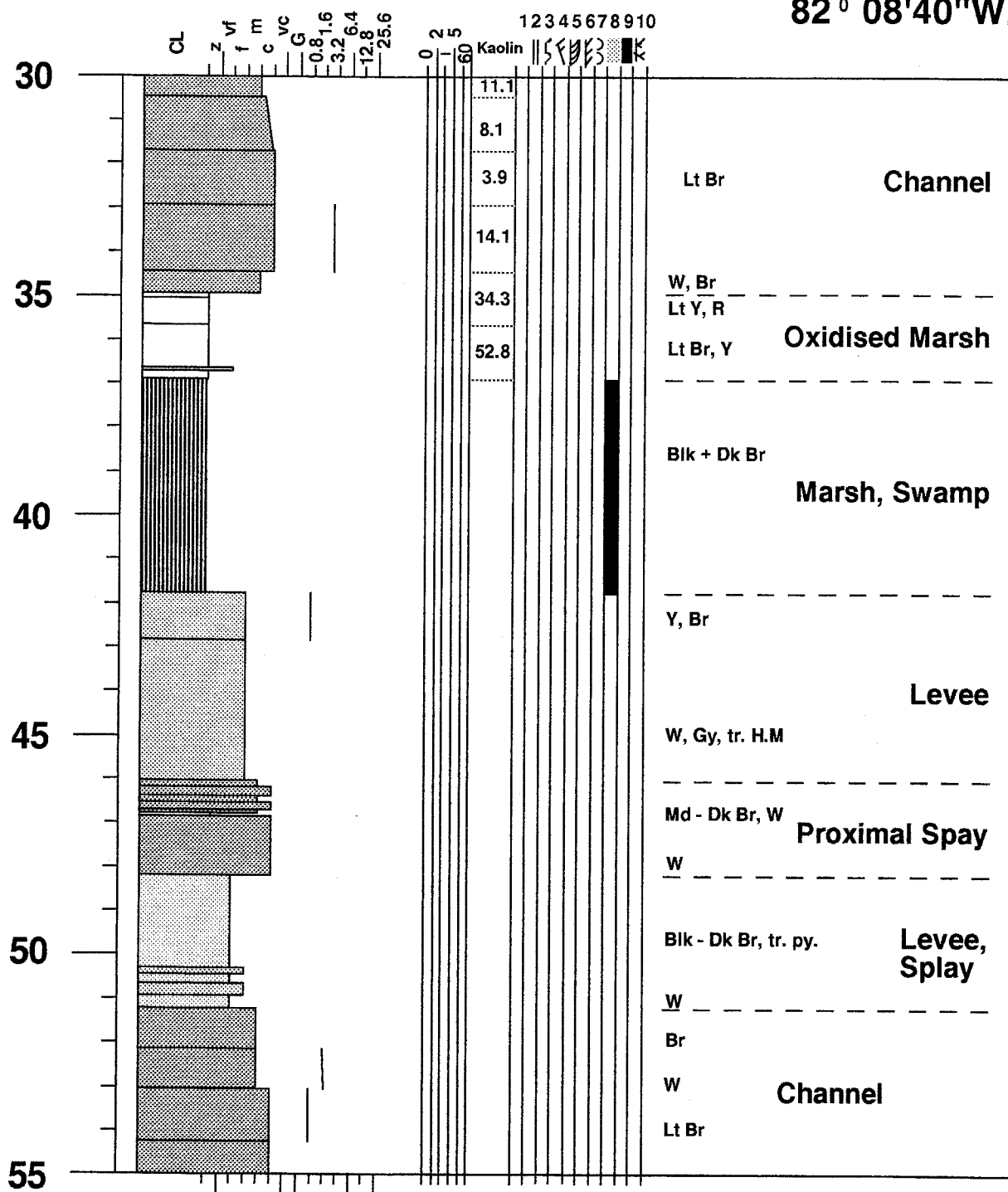
MRC hole 89 - 51, Kipling Twp.

50° 08'37"N,
82° 08'40"W.



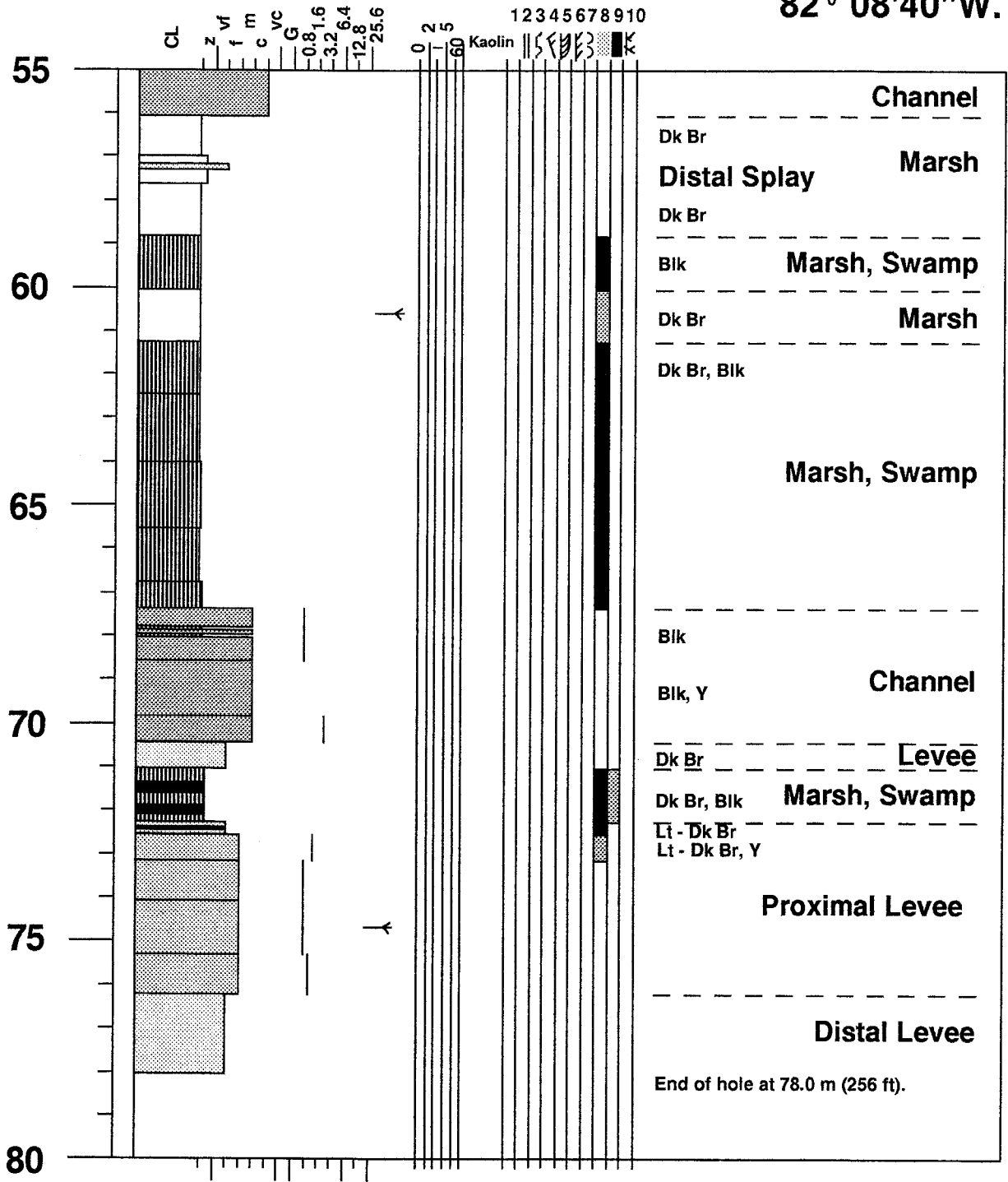
MRC hole 89 - 51, Kipling Twp.

50° 08'37"N,
82° 08'40"W.



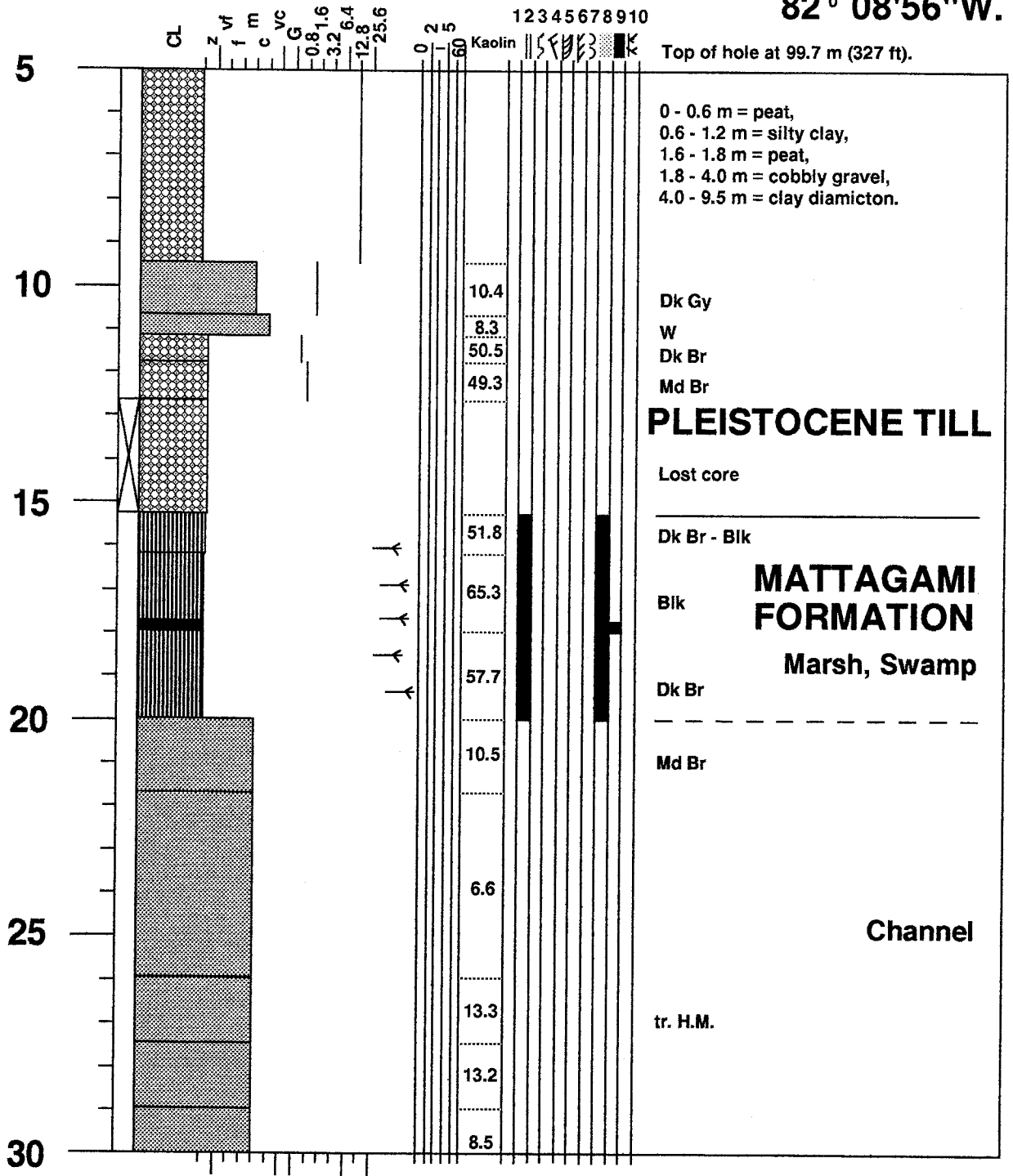
MRC hole 89 - 51, Kipling Twp.

50° 08'37"N,
82° 08'40"W.



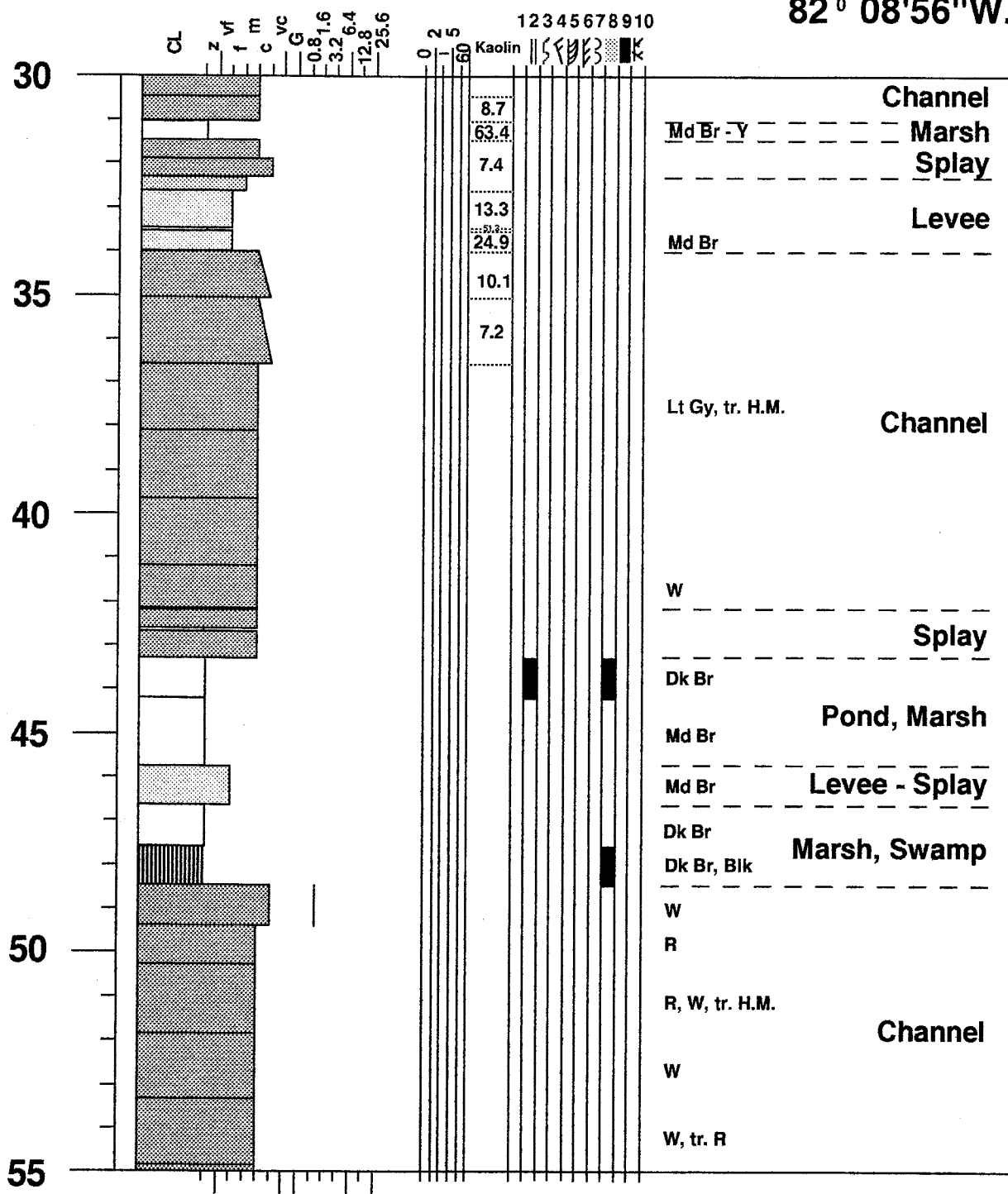
MRC hole 89 - 53, Kipling Twp.

50° 08'56"N,
82° 08'56"W.



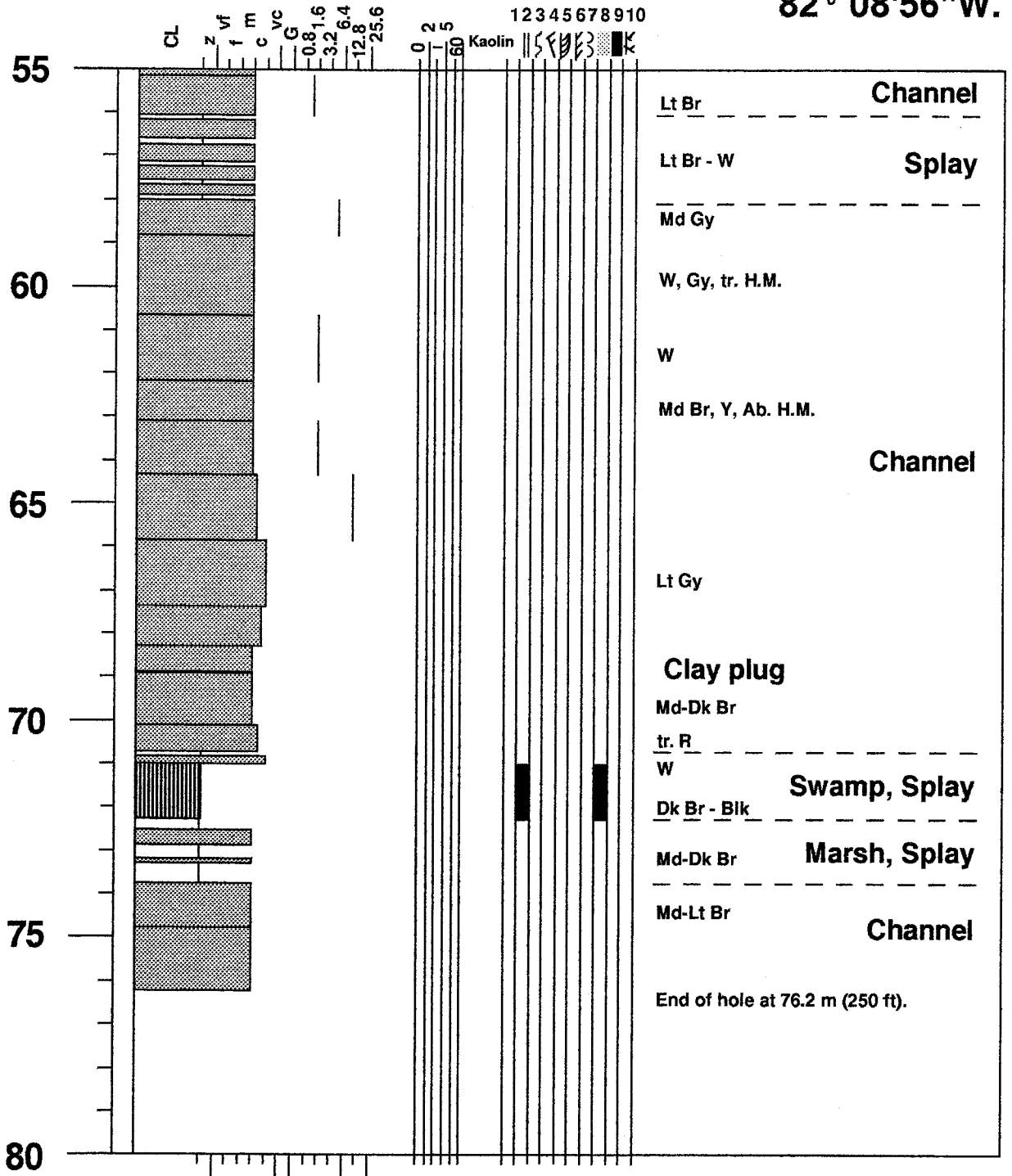
MRC hole 89 - 53, Kipling Twp.

50° 08'56"N,
82° 08'56"W.



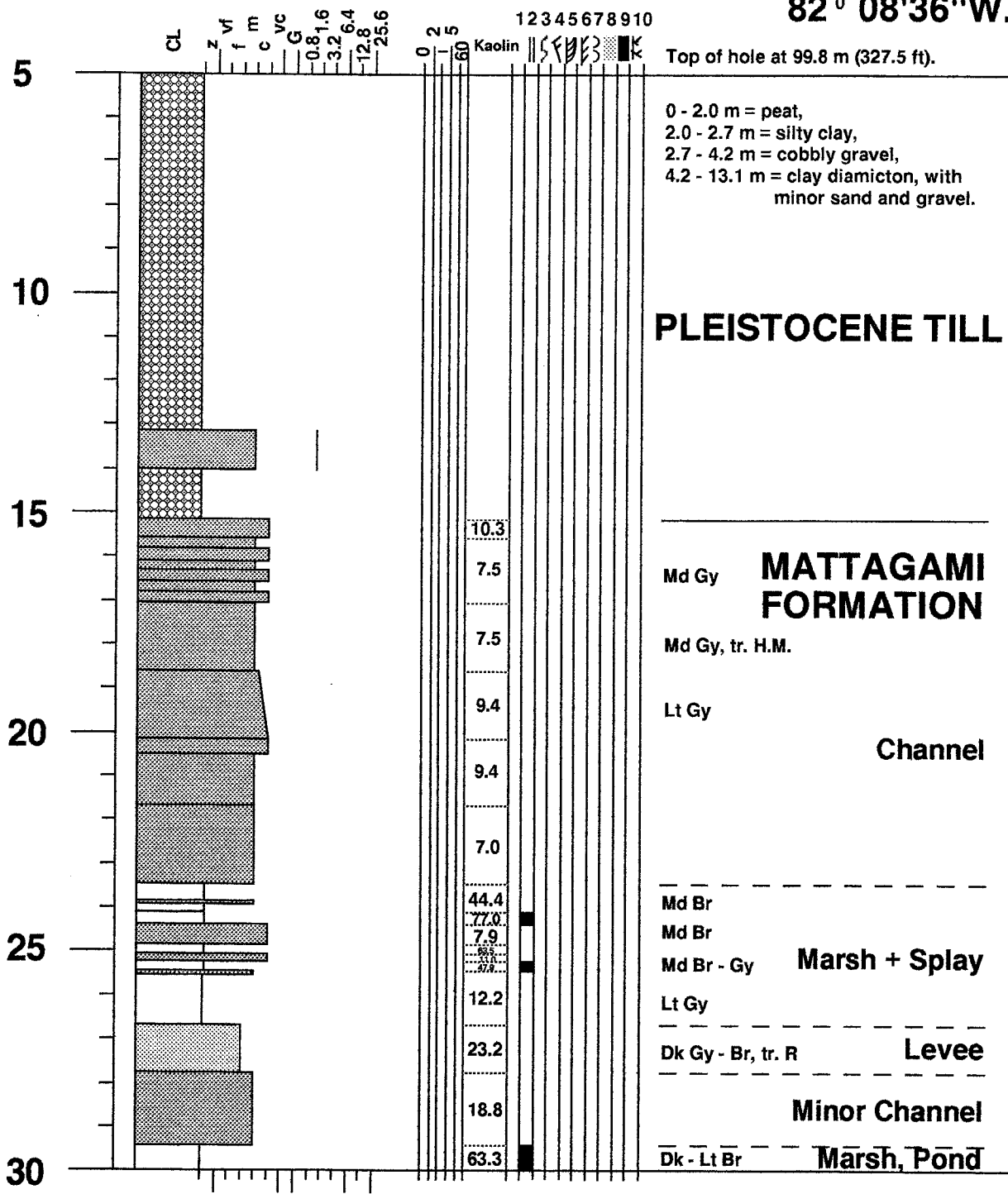
MRC hole 89 - 53, Kipling Twp.

50° 08'56"N,
82° 08'56"W.



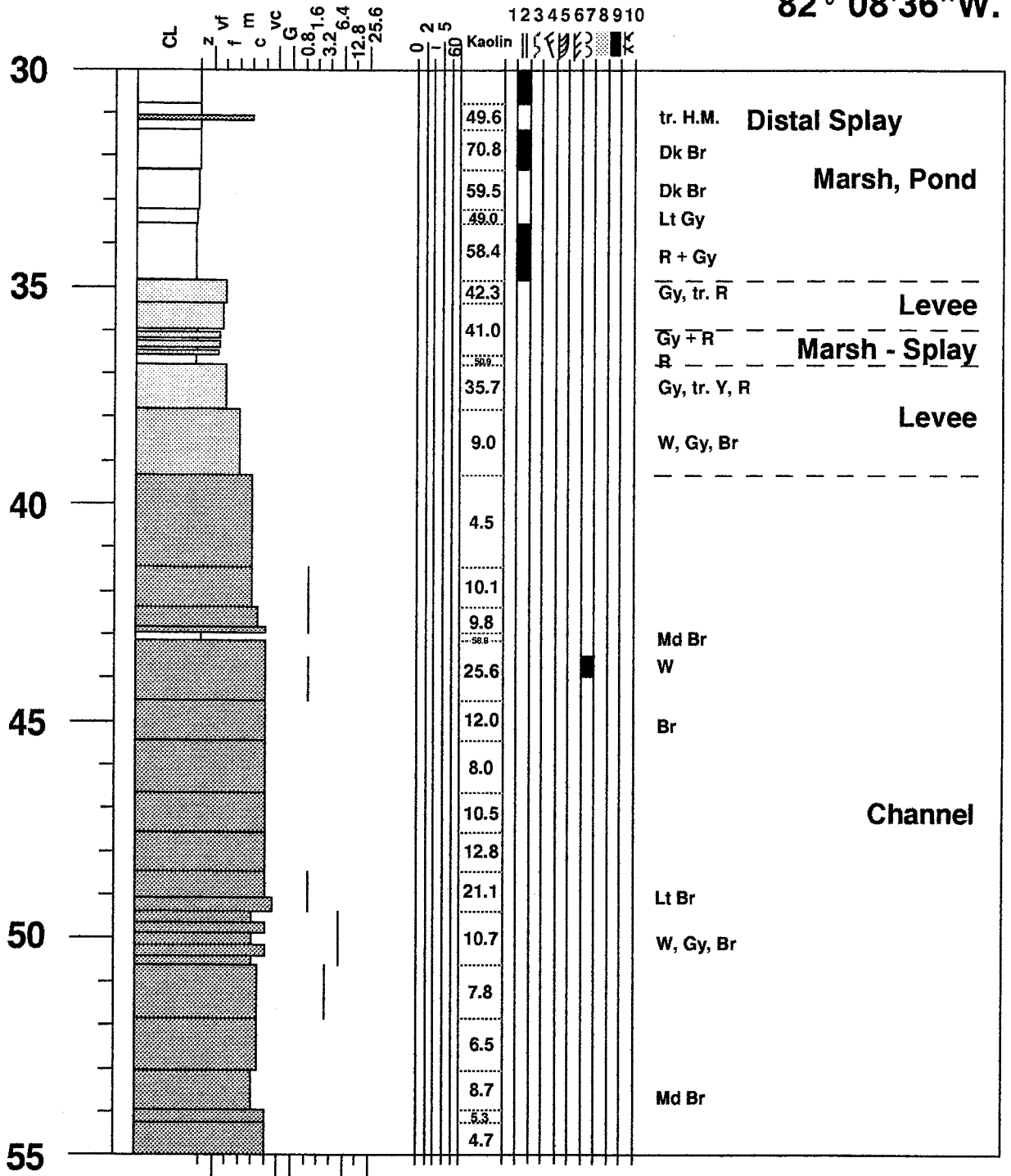
MRC hole 89 - 54, Kipling Twp.

50° 08'47"N,
82° 08'36"W.



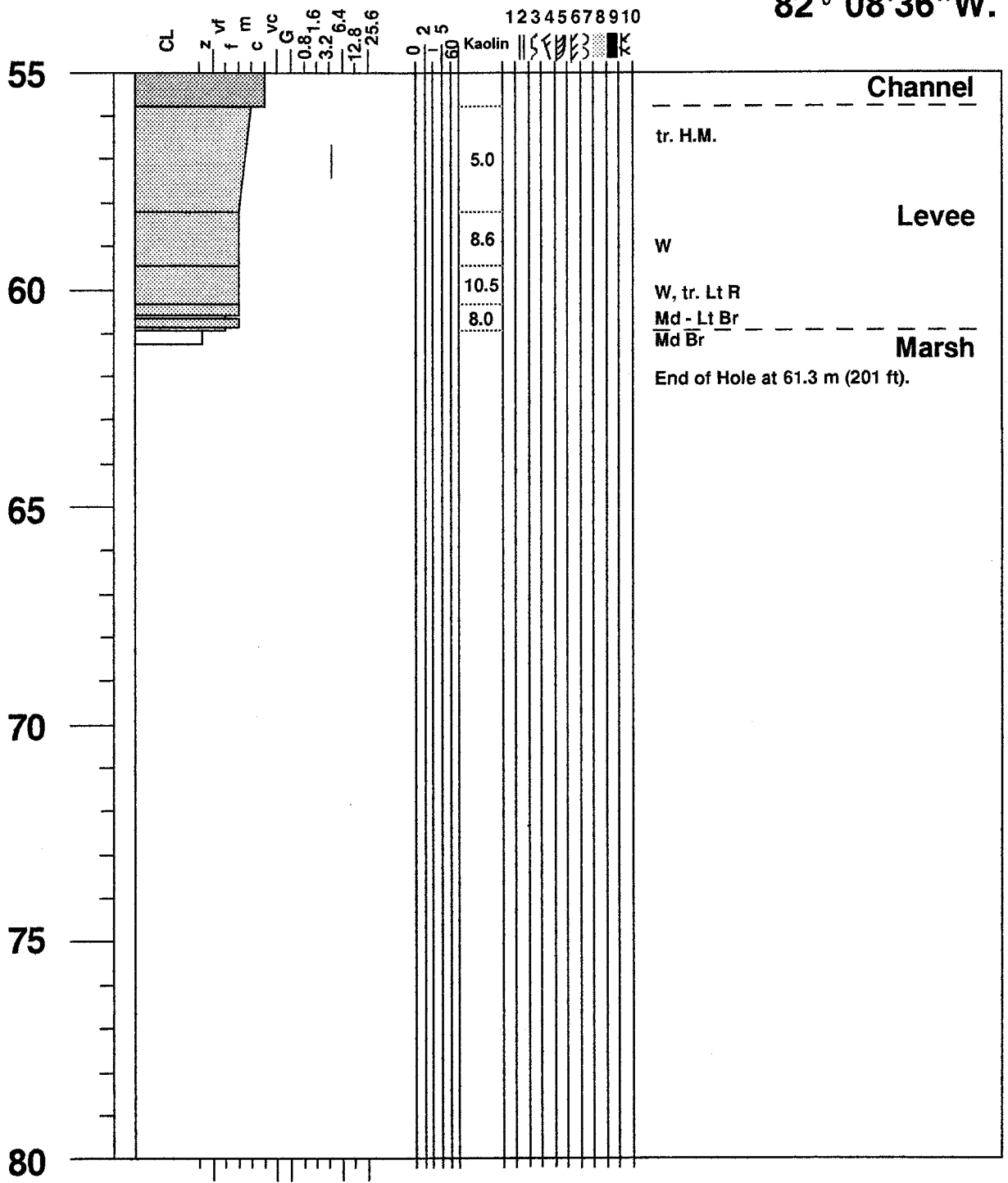
MRC hole 89 - 54, Kipling Twp.

50° 08'47"N,
82° 08'36"W.



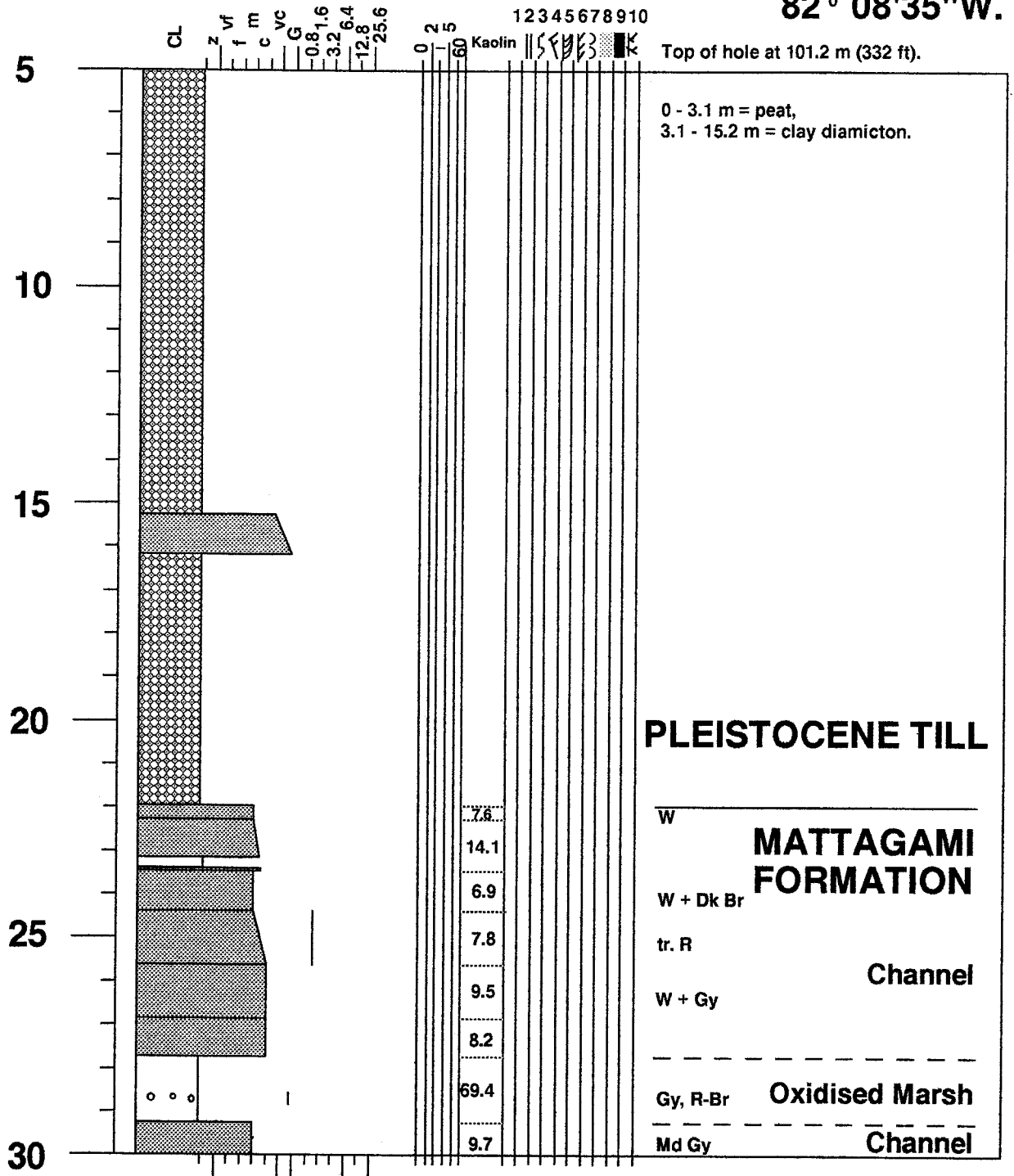
MRC hole 89 - 54, Kipling Twp.

50° 08'47"N,
82° 08'36"W.



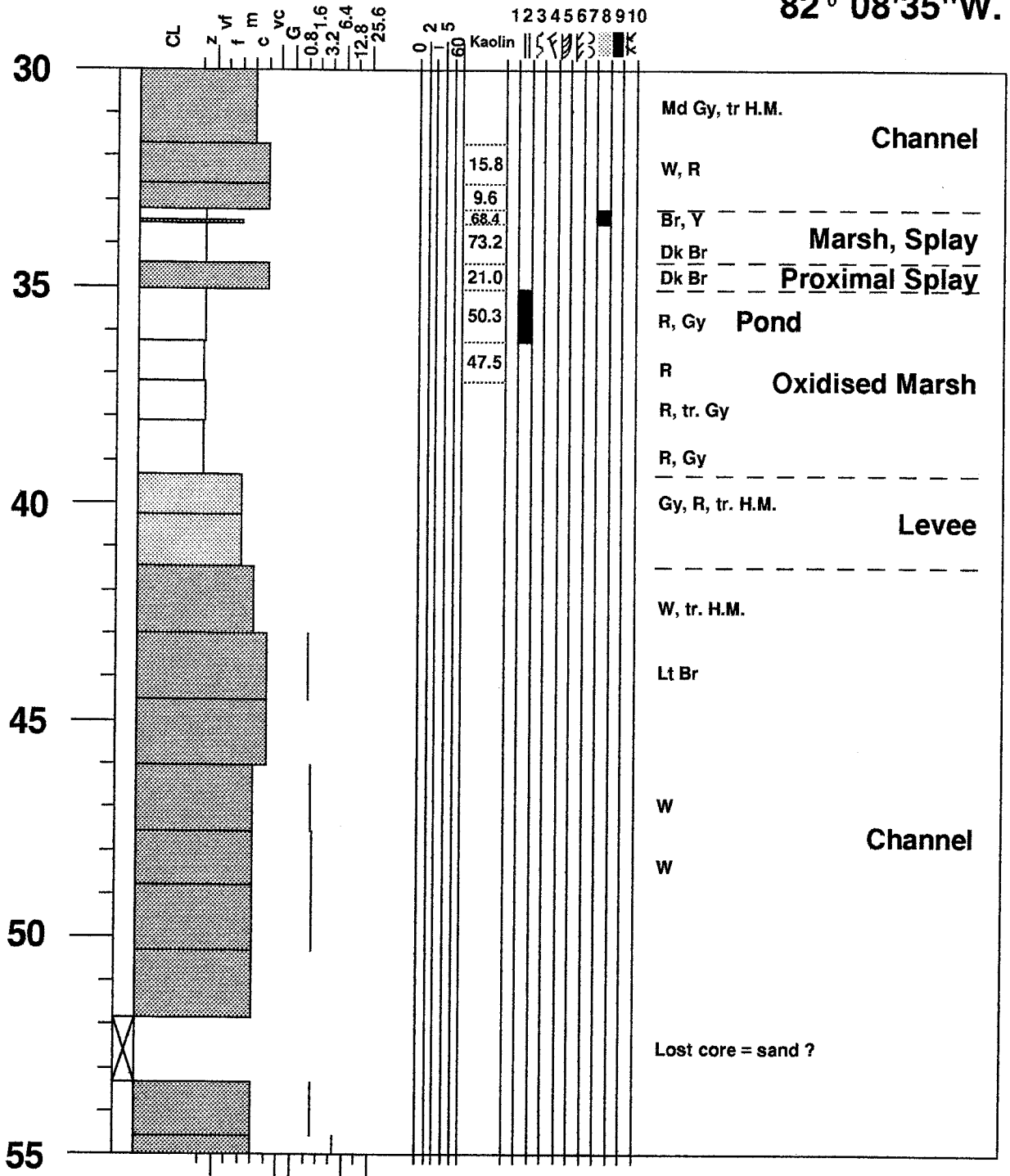
MRC hole 89 - 55, Kipling Twp.

50° 08'40"N,
82° 08'35"W.



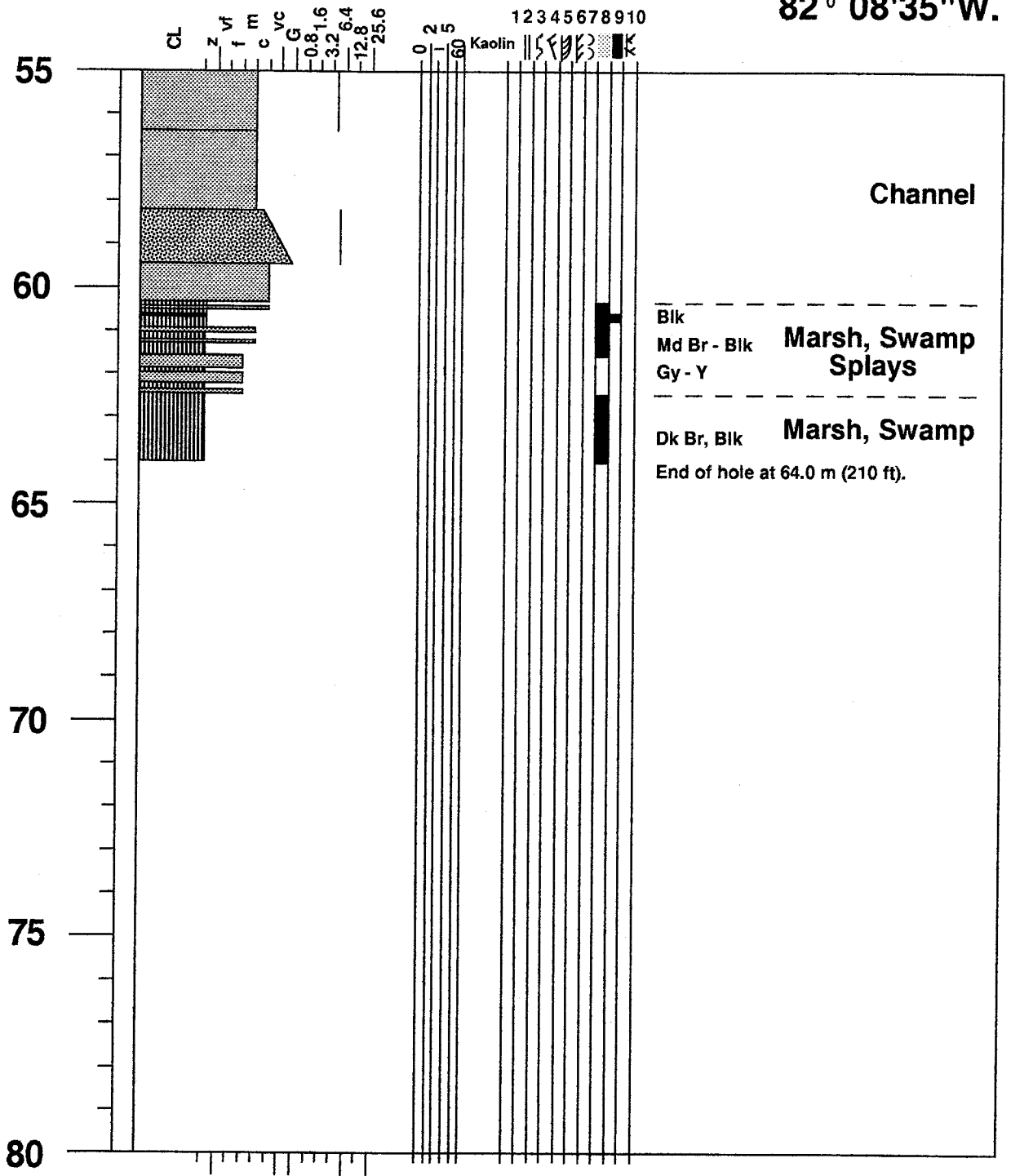
MRC hole 89 - 55, Kipling Twp.

50° 08'40"N,
82° 08'35"W.



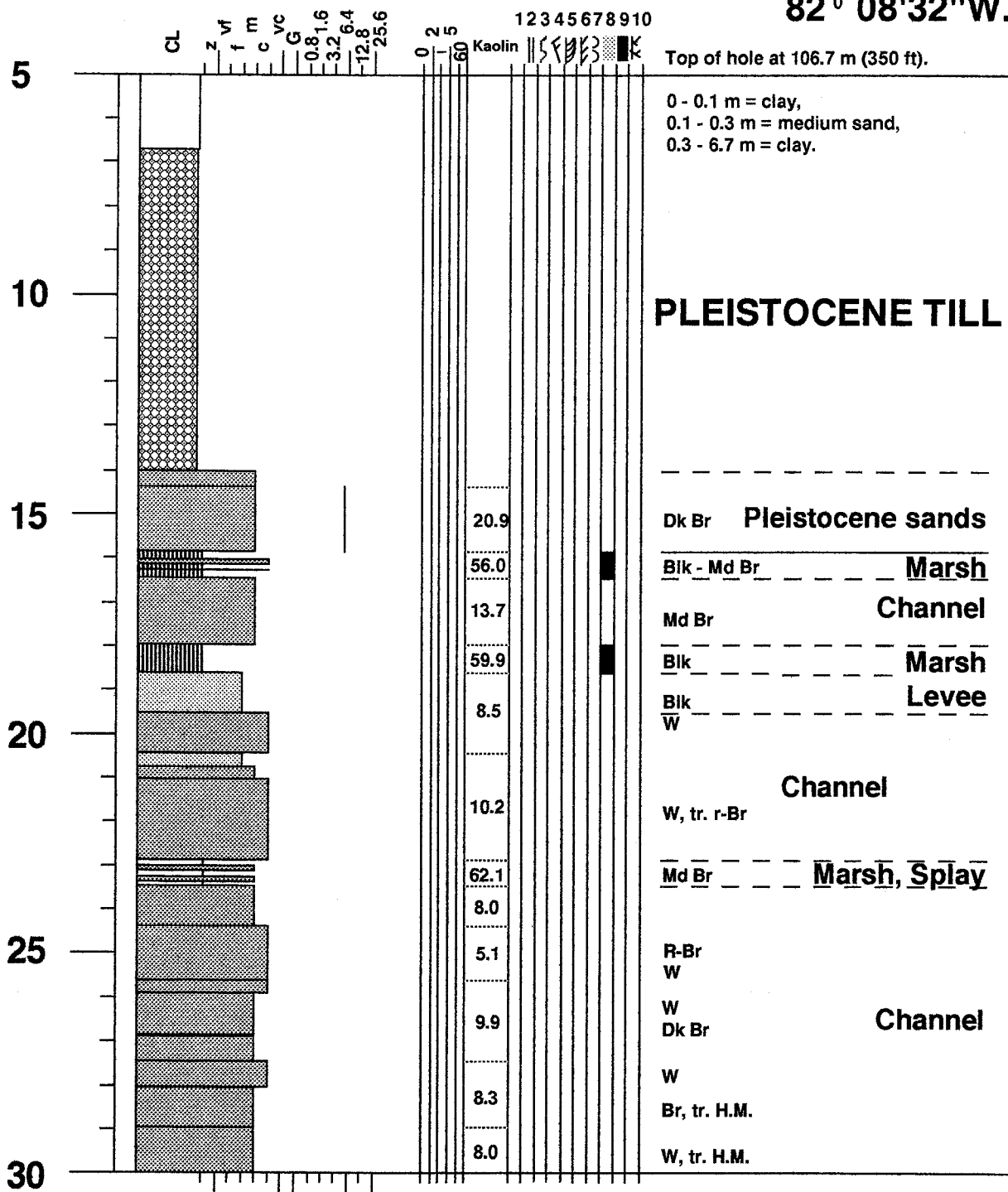
MRC hole 89 - 55, Kipling Twp.

50° 08'40"N,
82° 08'35"W.



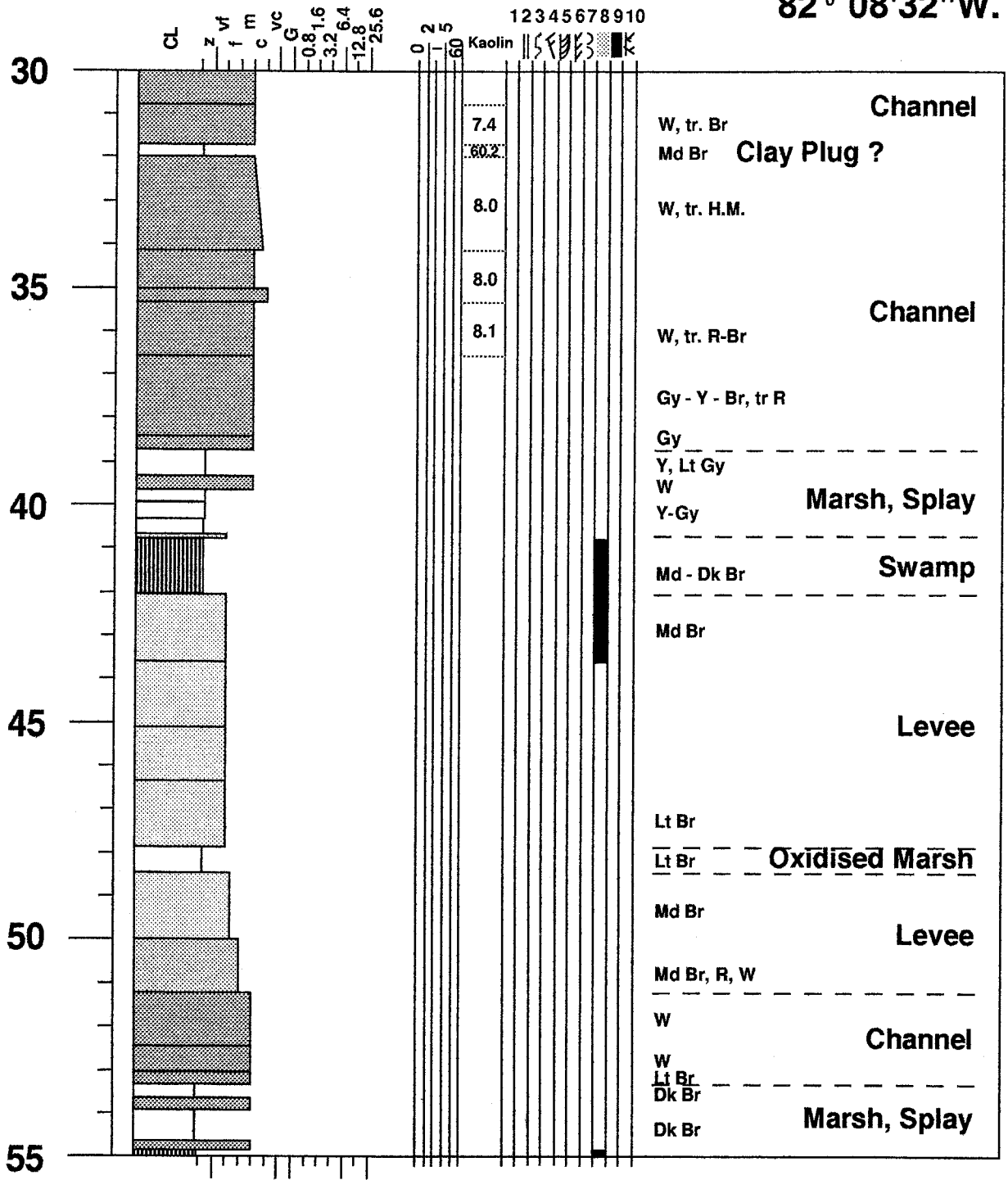
MRC hole 89 - 56, Kipling Twp.

50° 08'56"N,
82° 08'32"W.



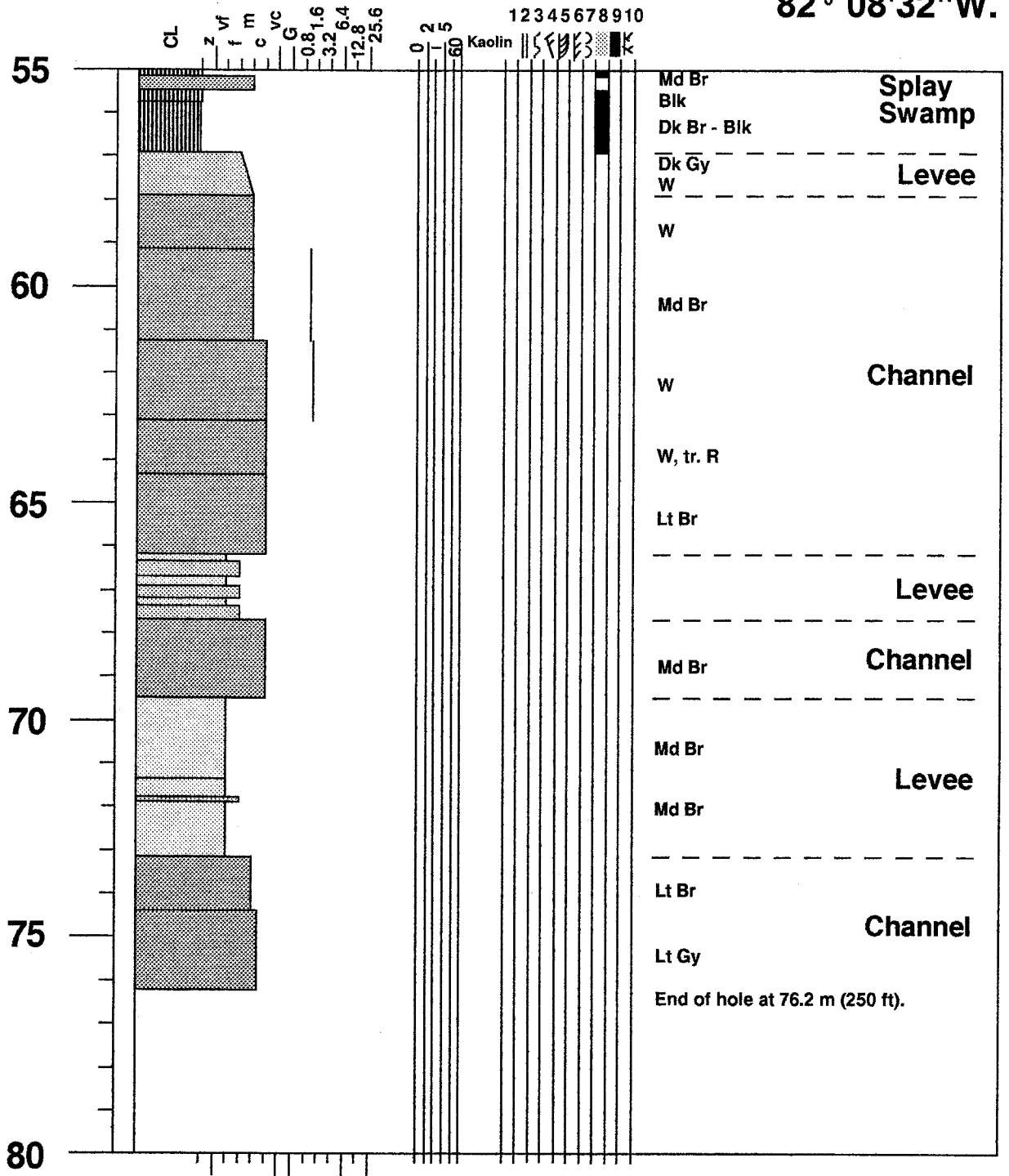
MRC hole 89 - 56, Kipling Twp.

50° 08'56"N,
82° 08'32"W.



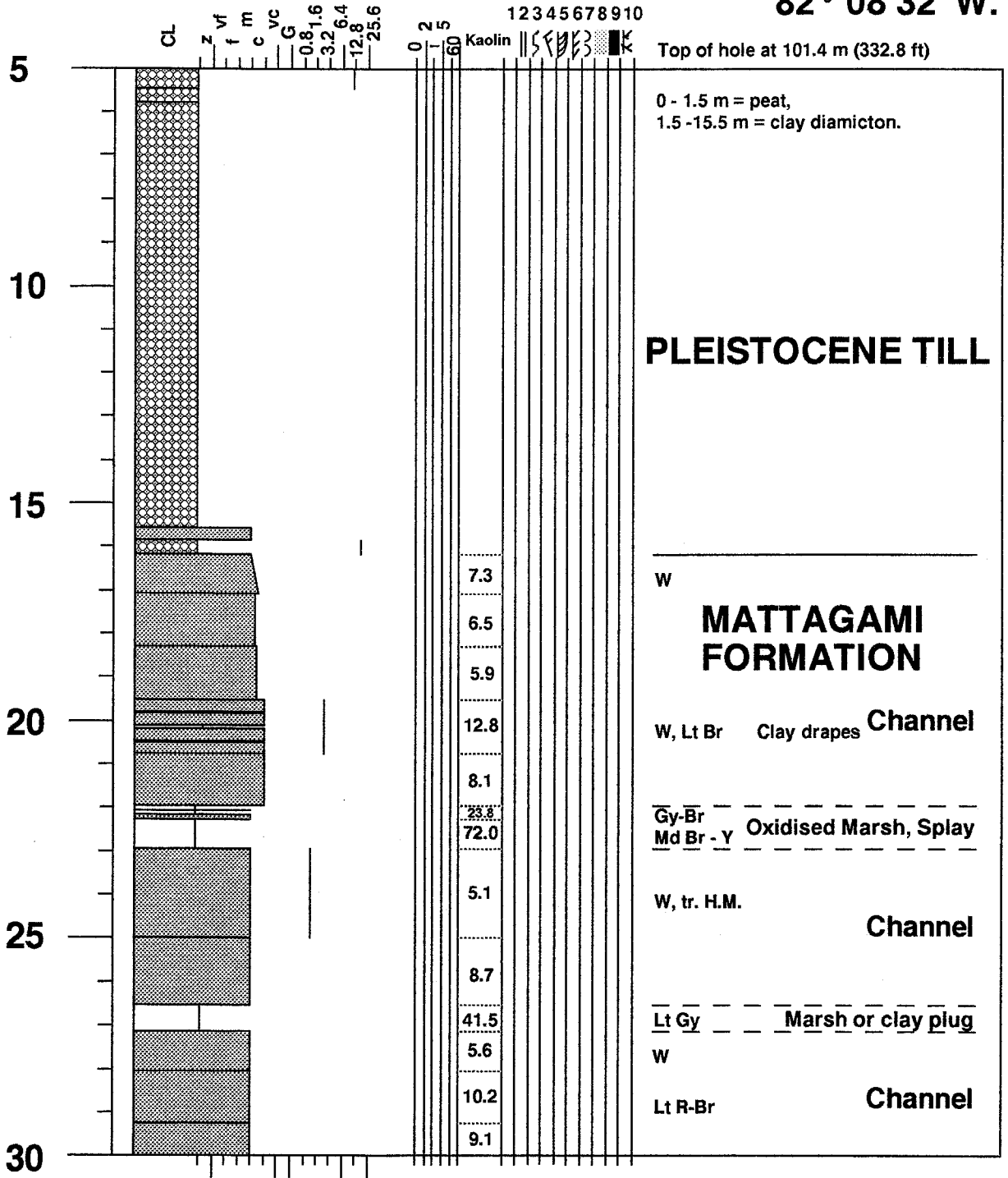
MRC hole 89 - 56, Kipling Twp.

50° 08'56"N,
82° 08'32"W.



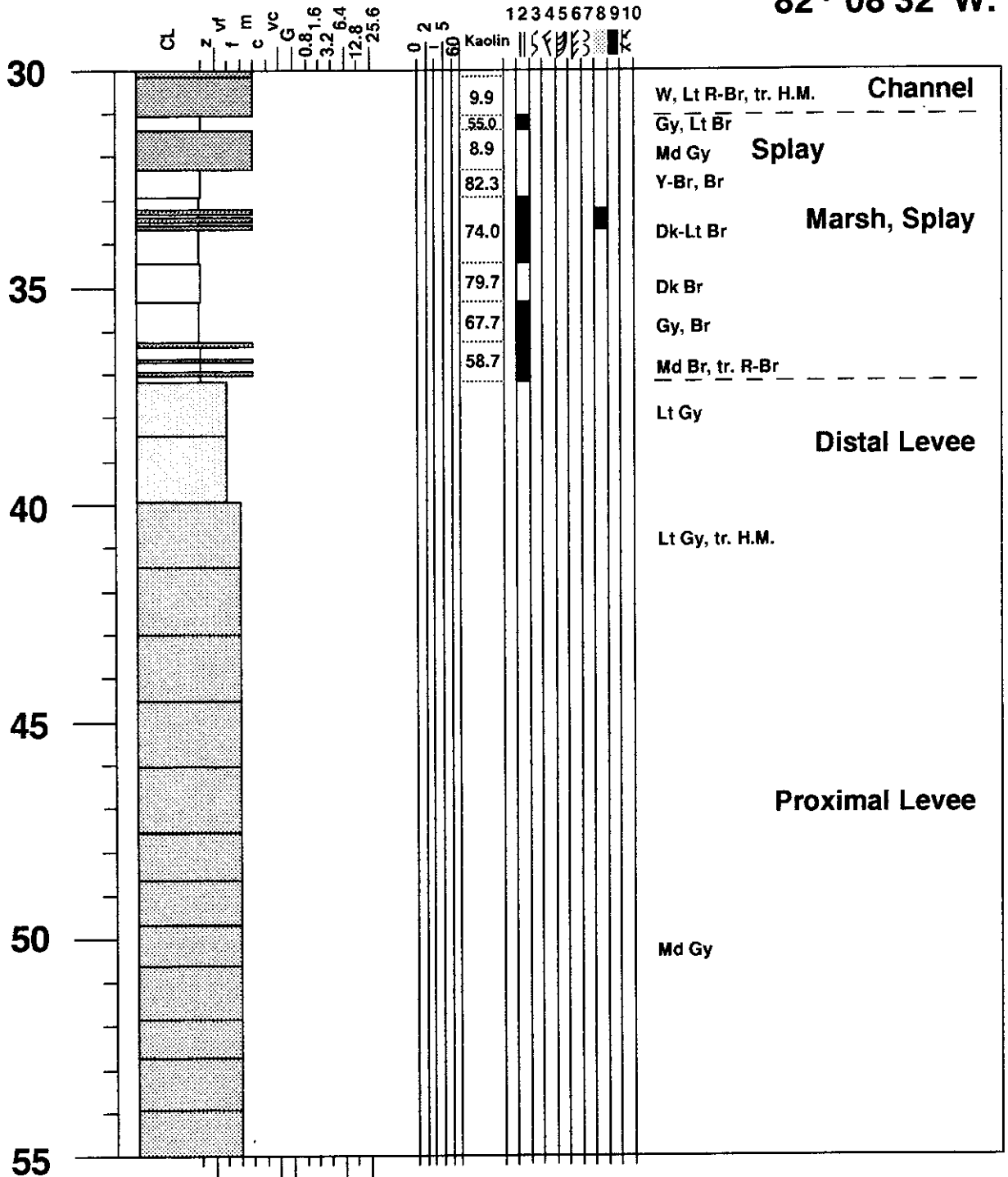
MRC hole 89 - 57, Kipling Twp.

50° 08'44"N,
82° 08'32"W.



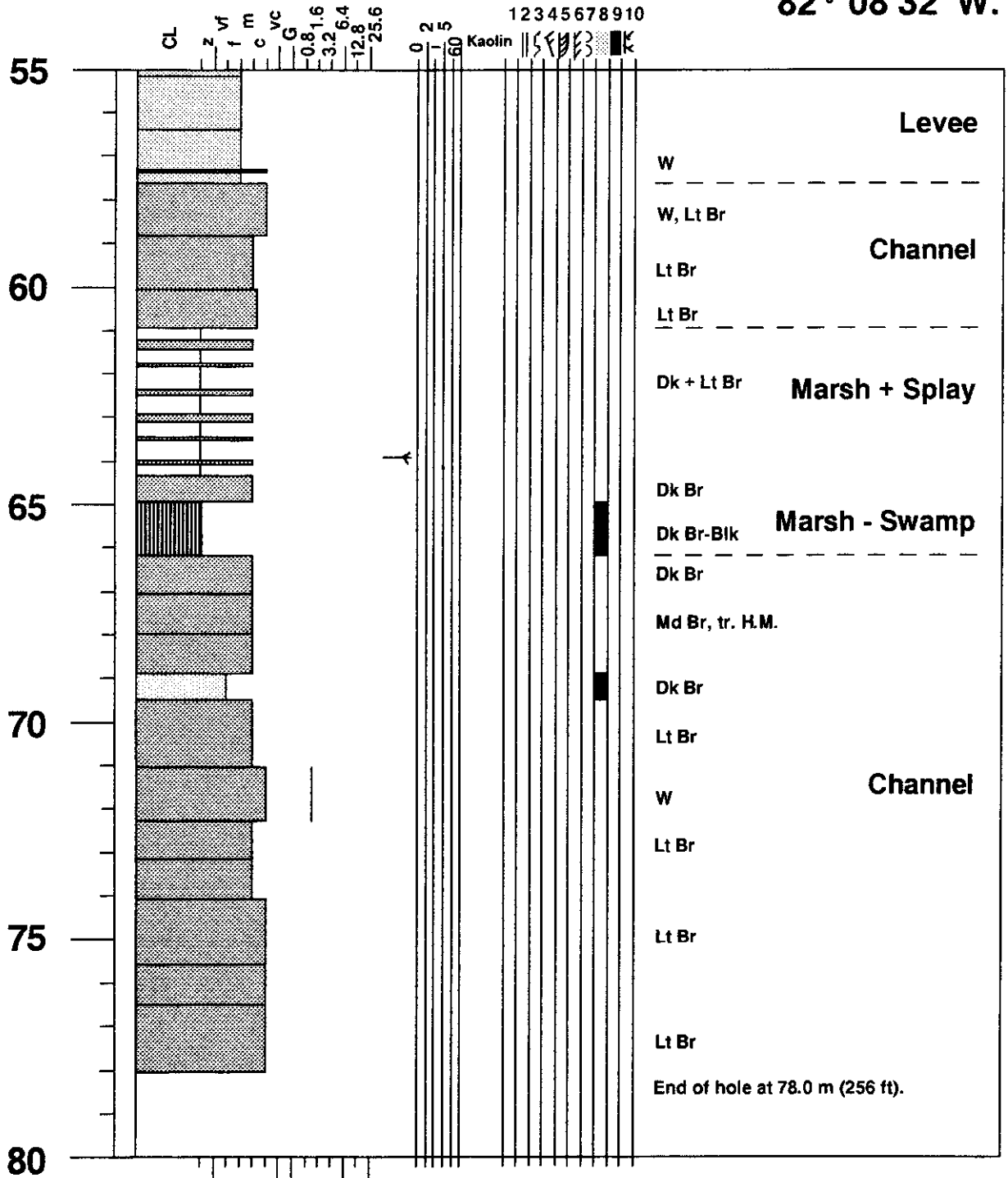
MRC hole 89 - 57, Kipling Twp.

50° 08'44"N,
82° 08'32"W.



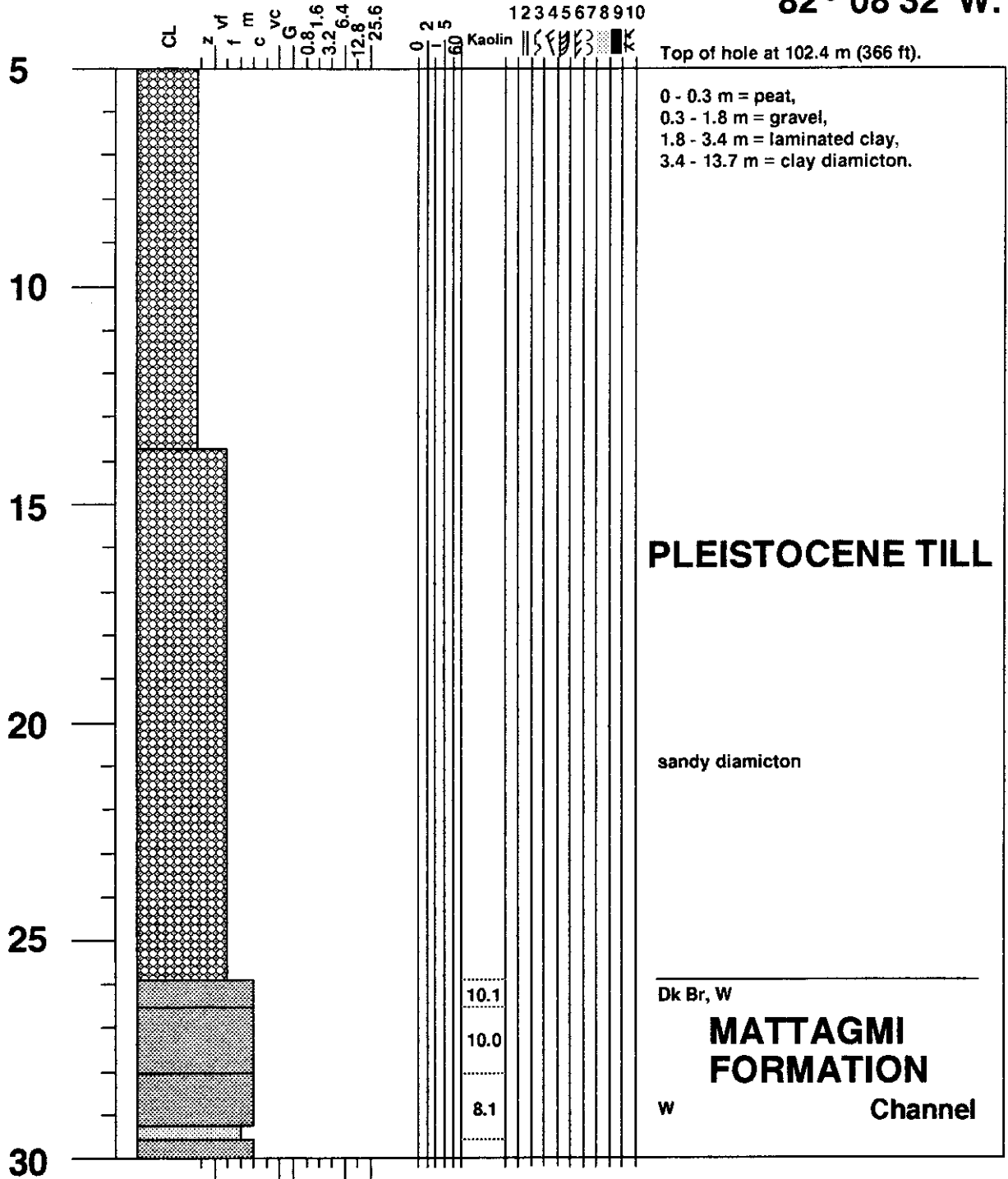
MRC hole 89 - 57, Kipling Twp.

50° 08'44"N,
82° 08'32"W.



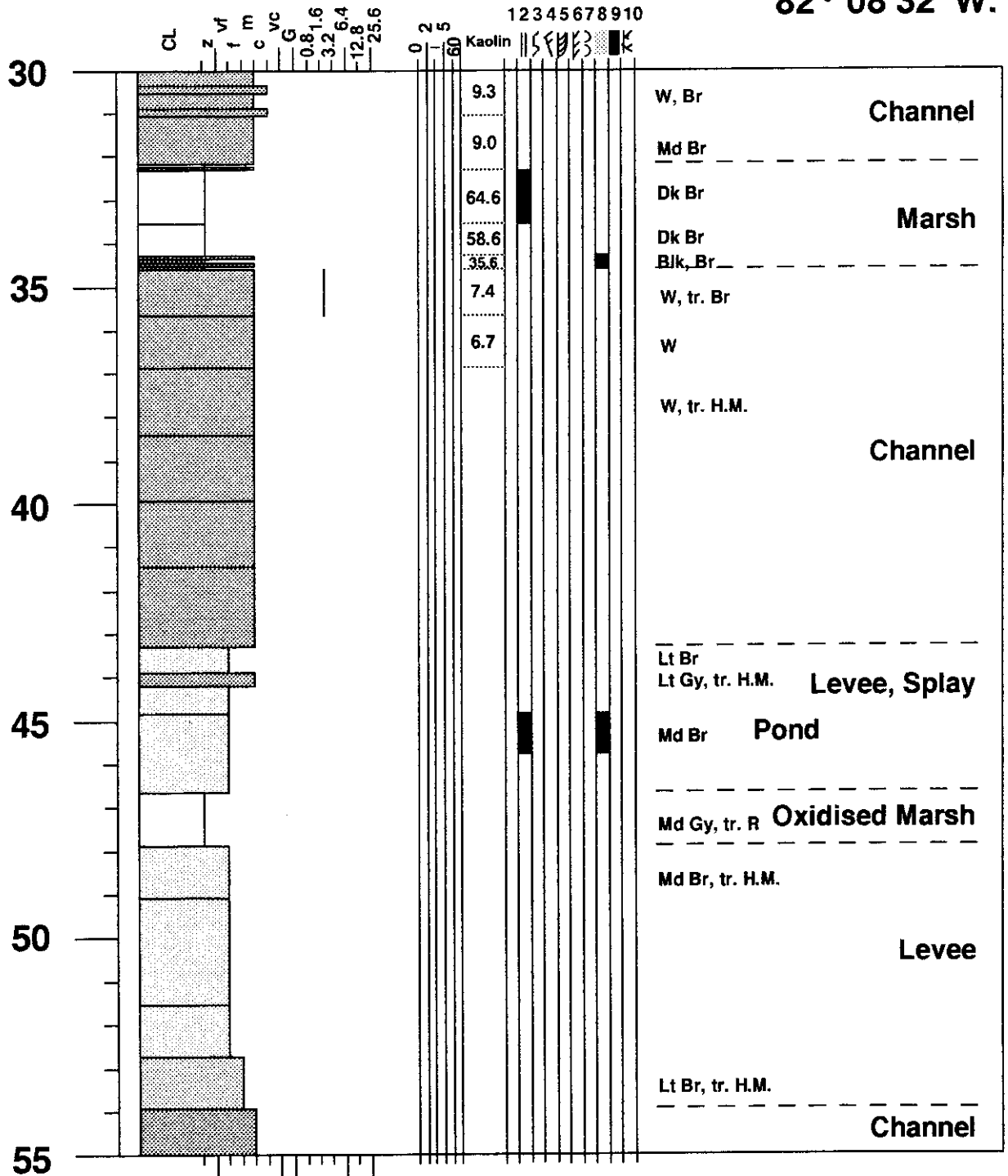
MRC hole 89 - 58, Kipling Twp.

50° 08'38"N,
82° 08'32"W.



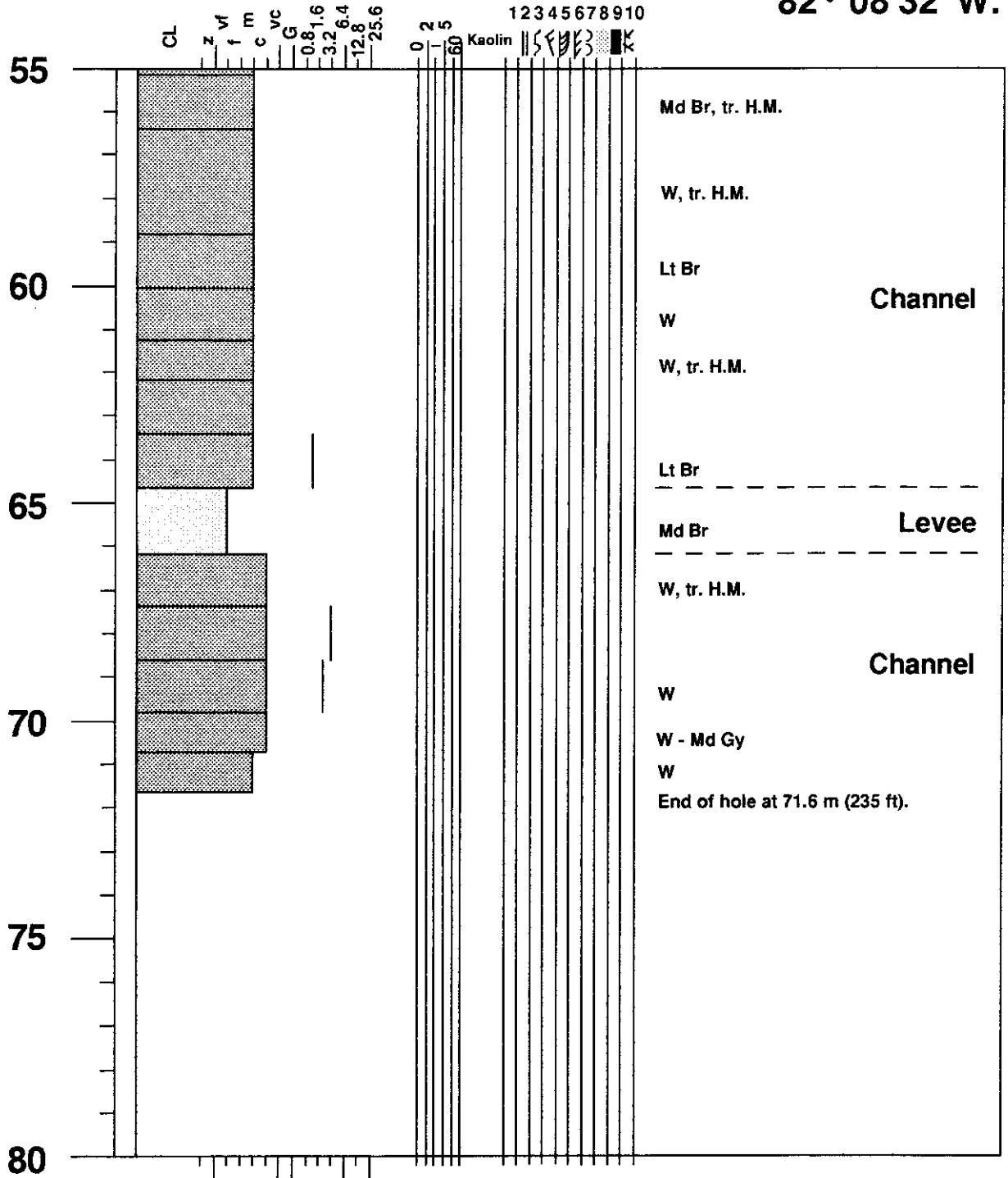
MRC hole 89 - 58, Kipling Twp.

50° 08'38"N,
82° 08'32"W.



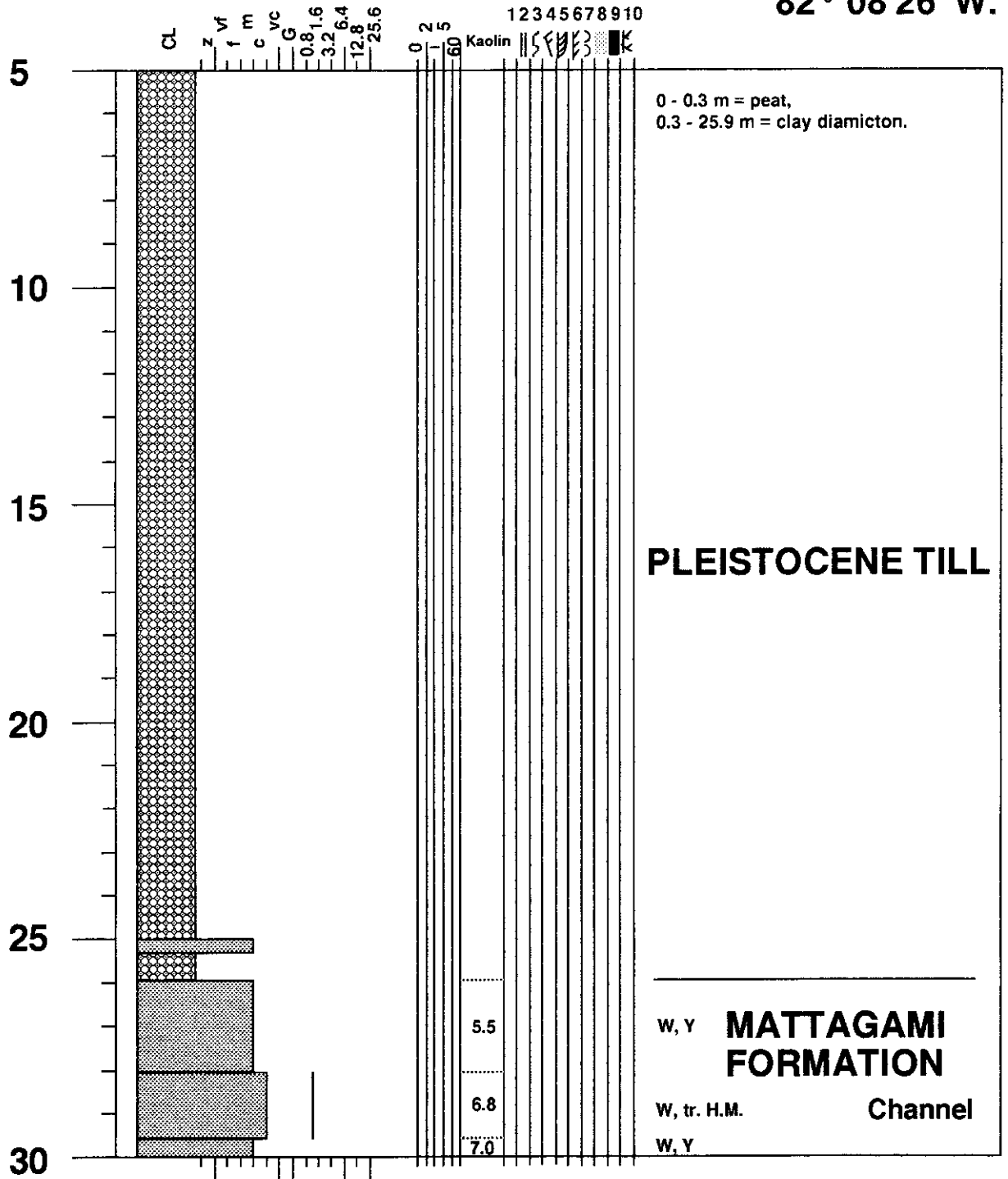
MRC hole 89 - 58, Kipling Twp.

50° 08'38"N,
82° 08'32"W.



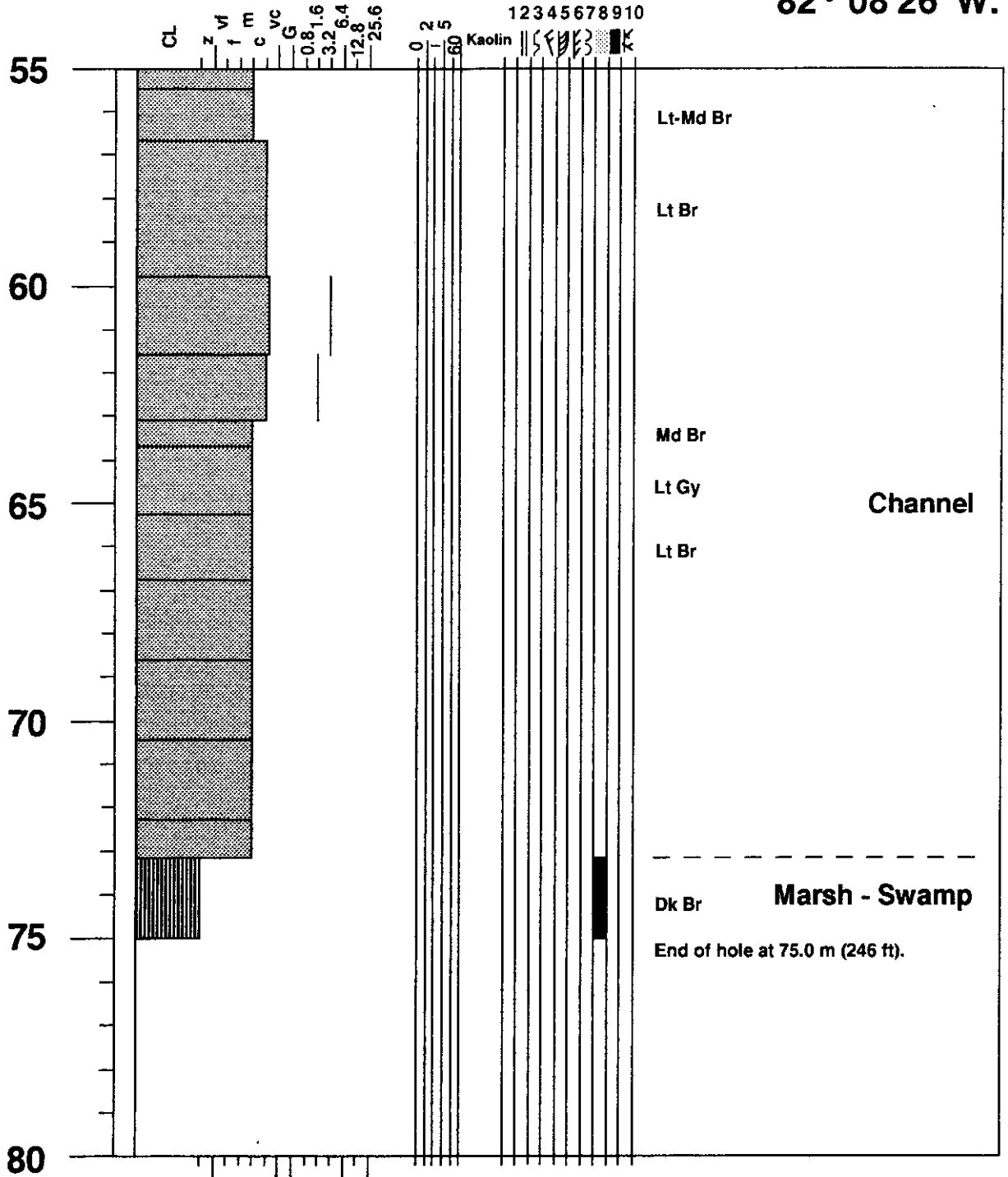
MRC hole 89 - 59, Kipling Twp.

50° 08'59"N,
82° 08'26"W.



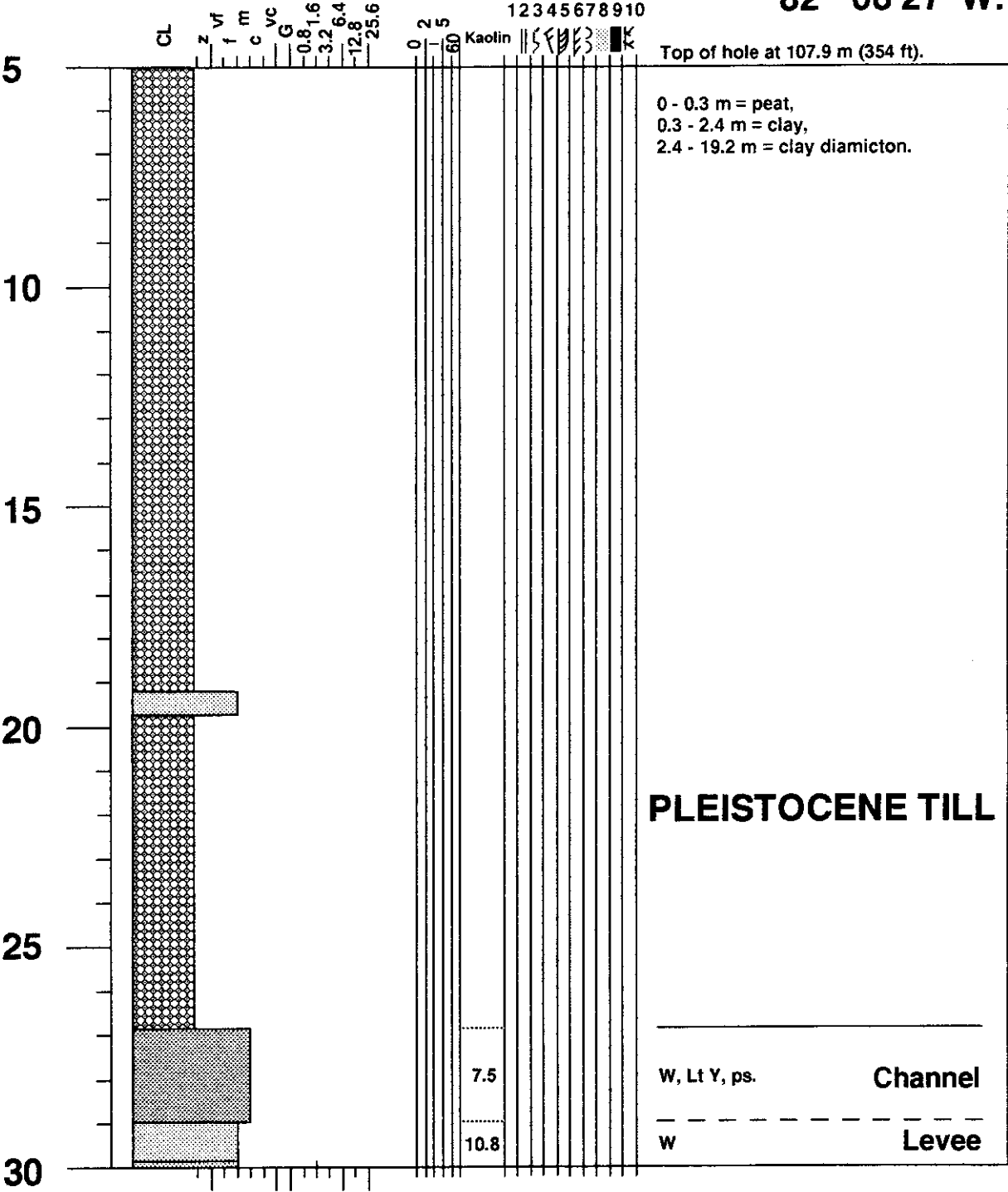
MRC hole 89 - 59, Kipling Twp.

**50° 08'59"N,
82° 08'26"W.**



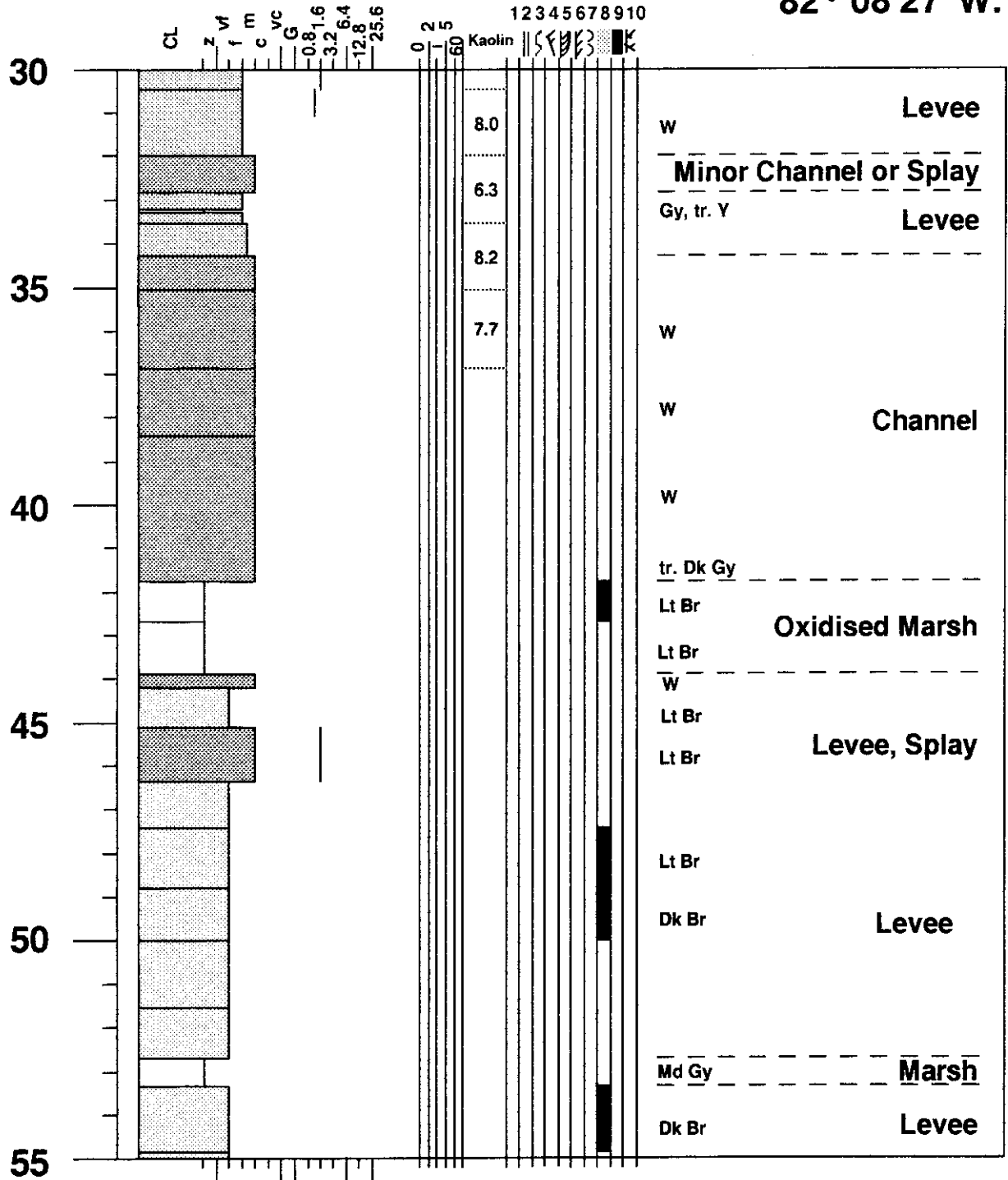
MRC hole 89 - 60, Kipling Twp.

50° 08'53"N,
82° 08'27"W.



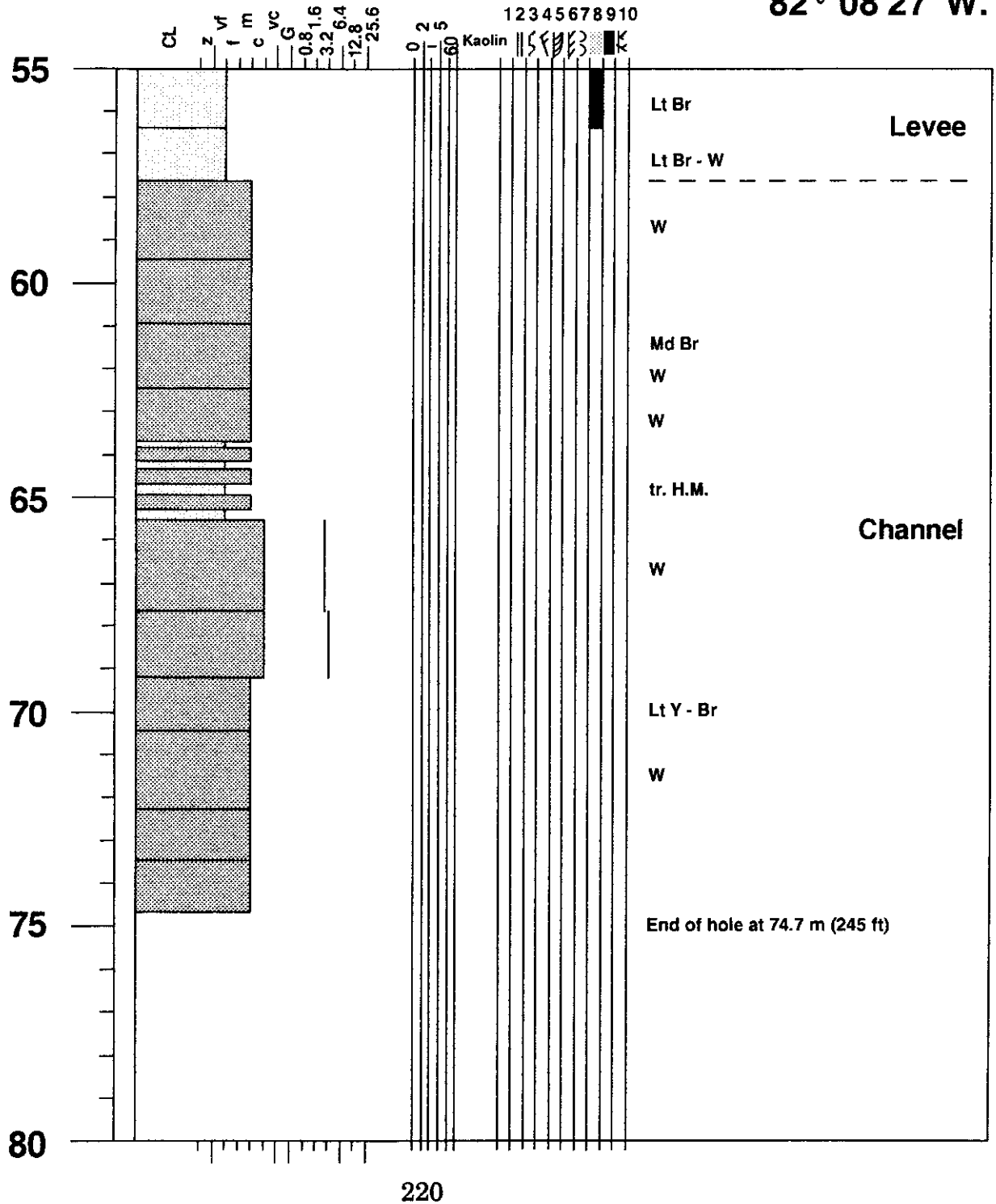
MRC hole 89 - 60, Kipling Twp.

50° 08'53"N,
82° 08'27"W.



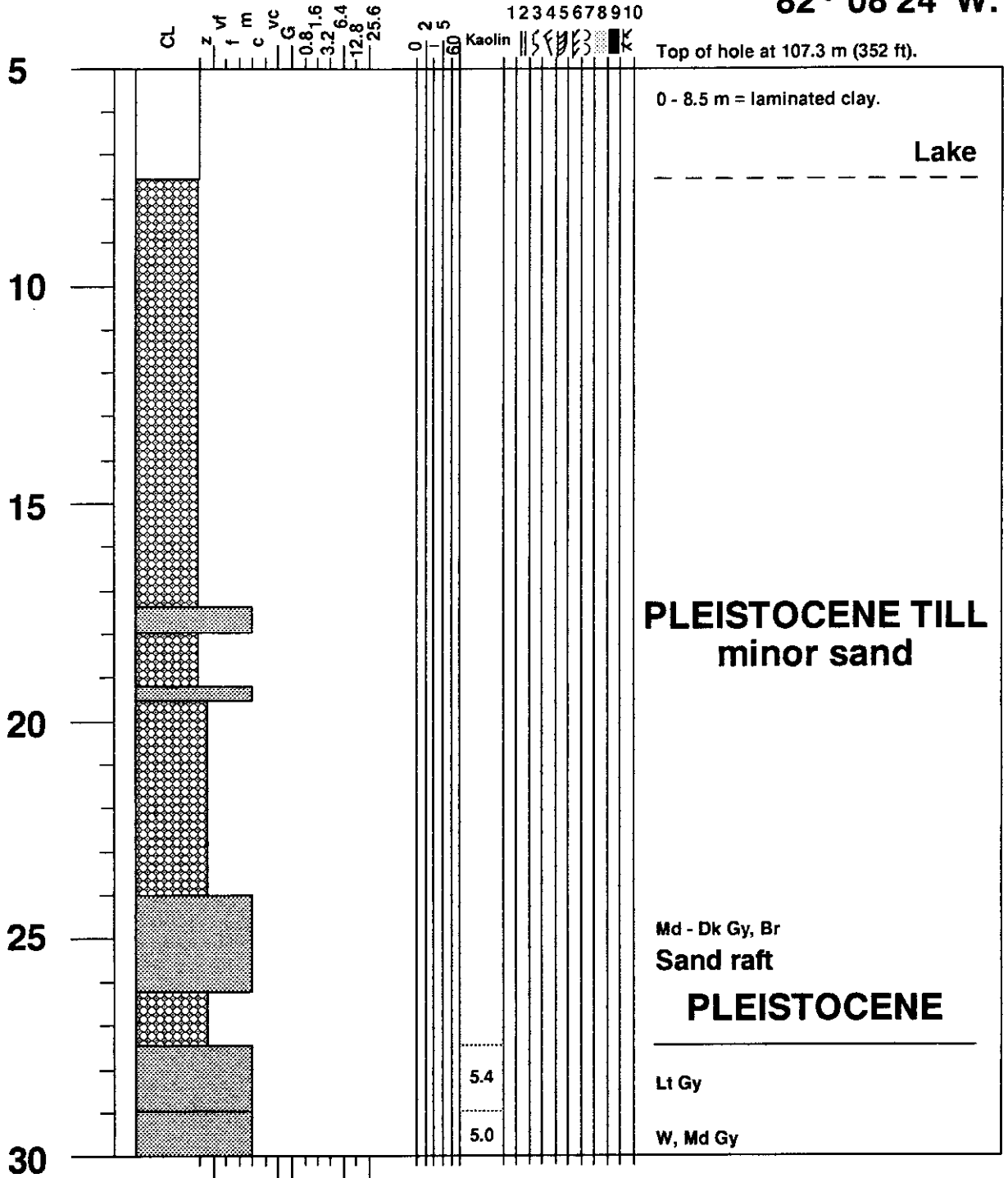
MRC hole 89 - 60, Kipling Twp.

50° 08'53"N,
82° 08'27"W.



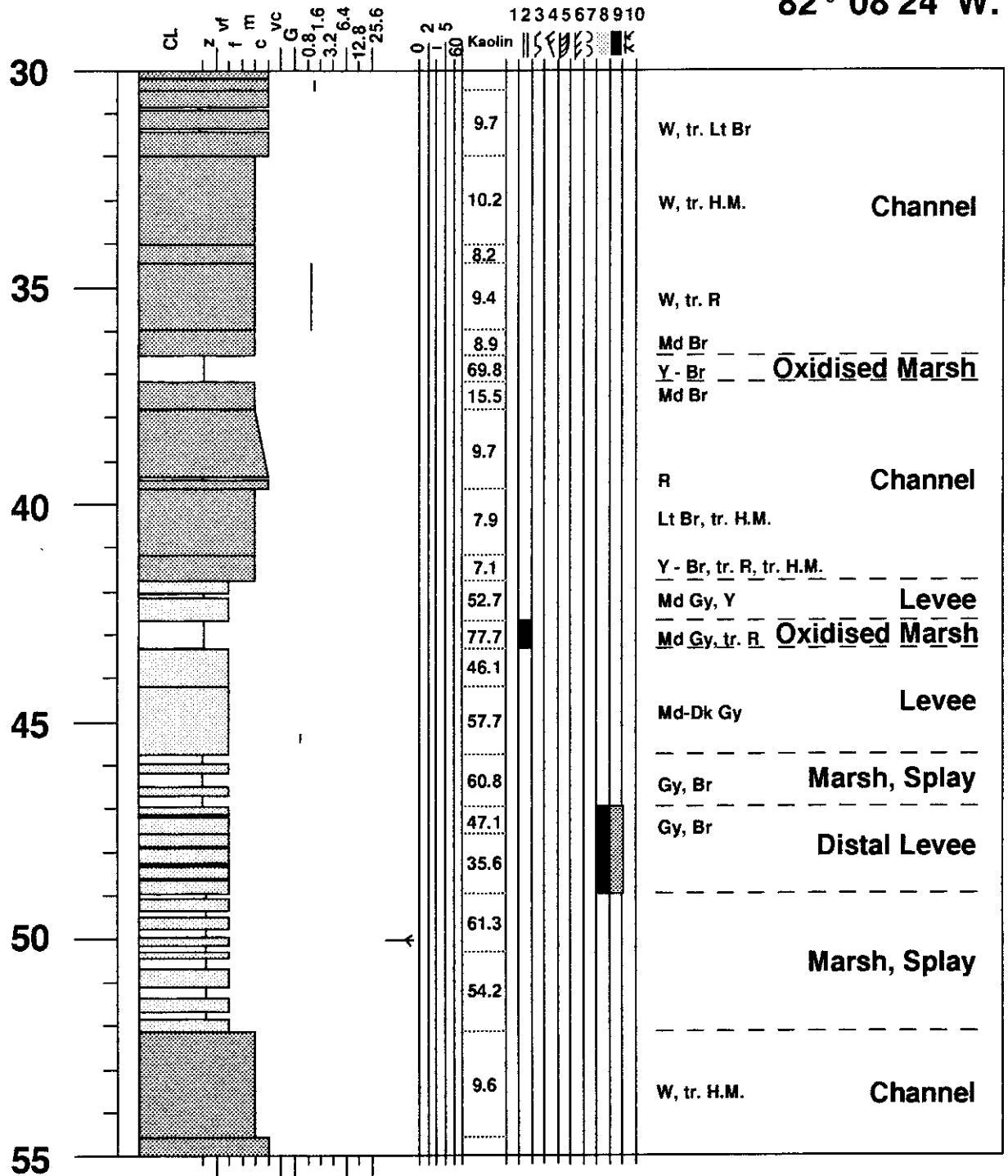
MRC hole 89 - 61, Kipling Twp.

50° 08'47"N,
82° 08'24"W.



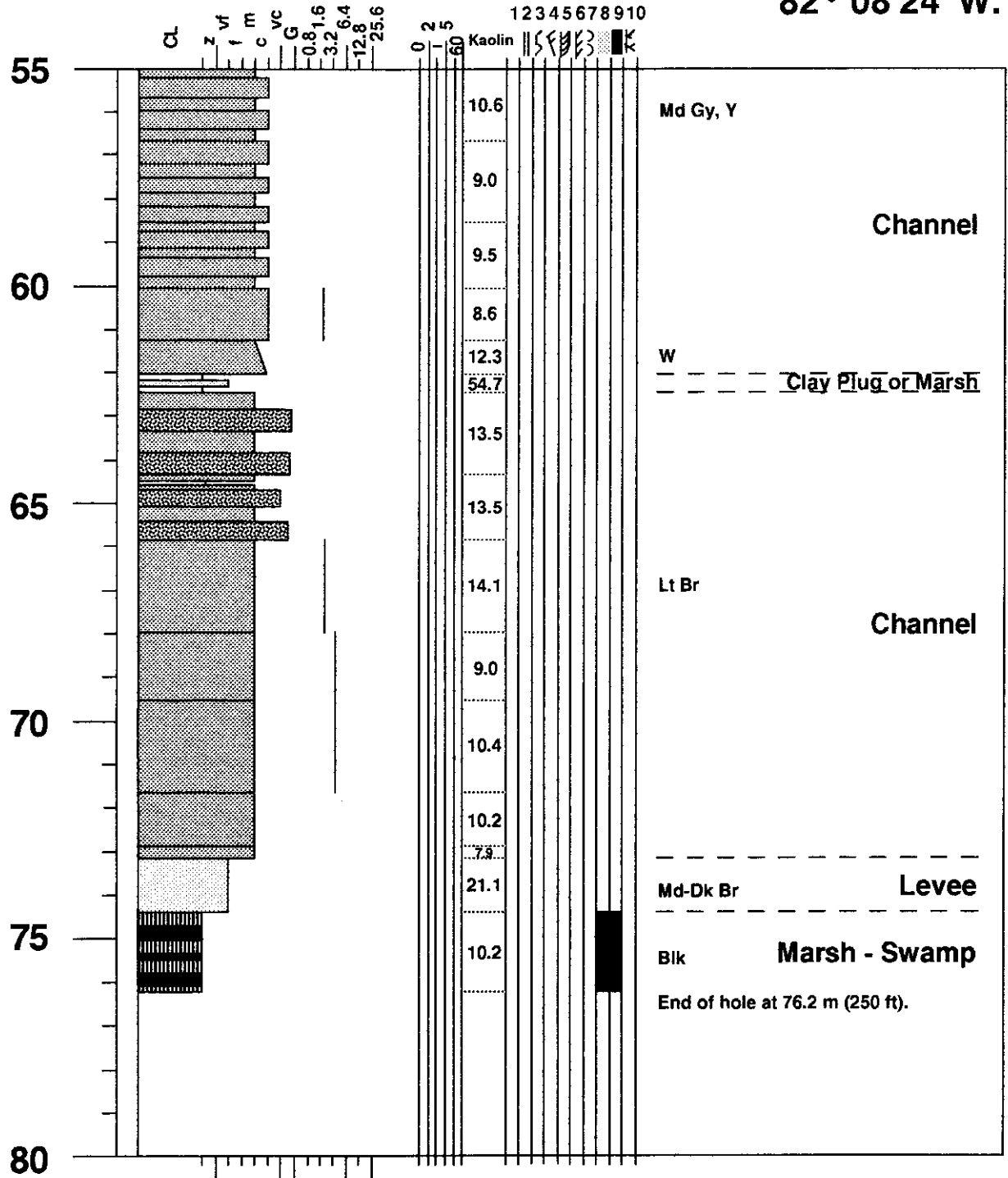
MRC hole 89 - 61, Kipling Twp.

50° 08'47"N,
82° 08'24"W.



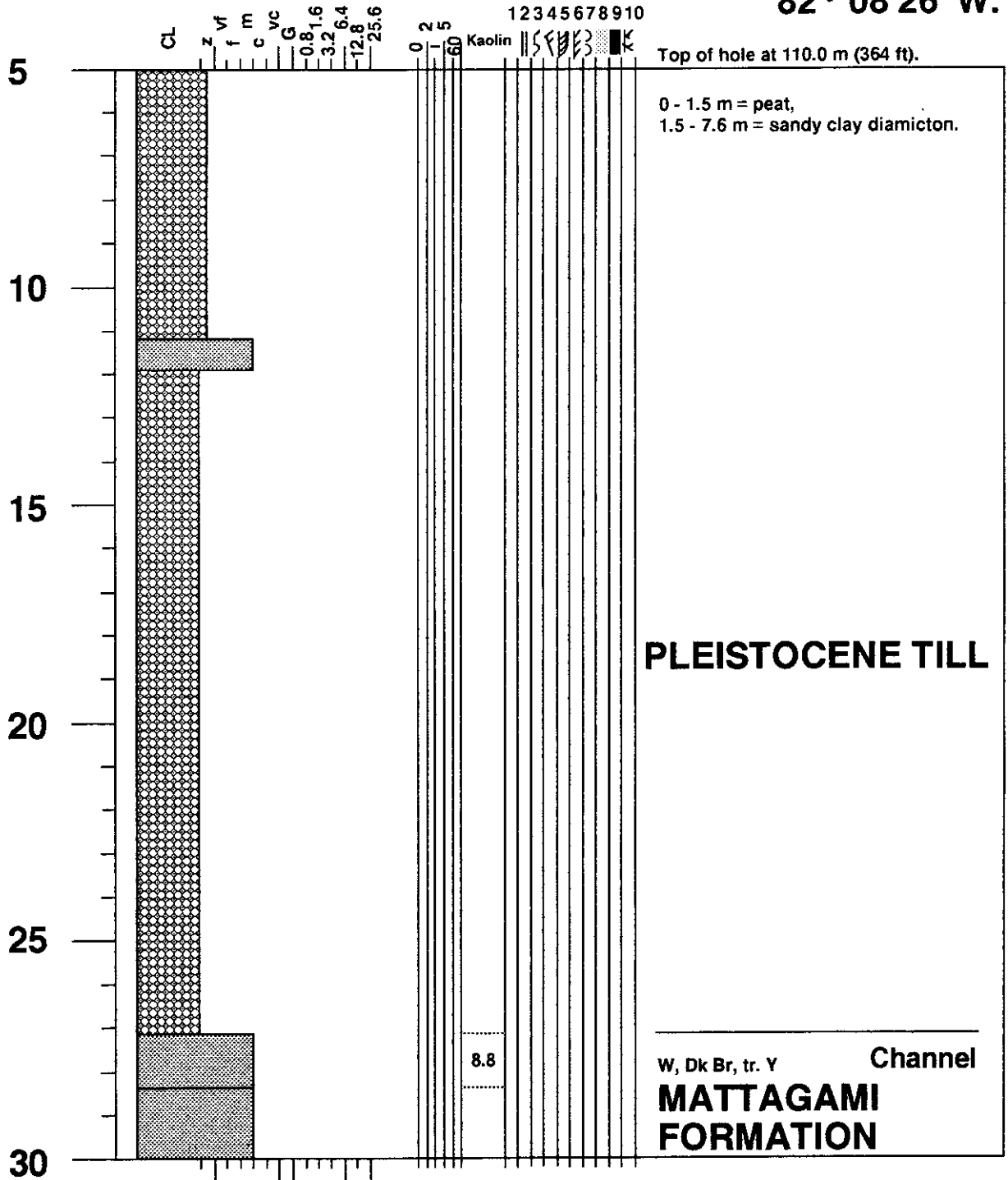
MRC hole 89 - 61, Kipling Twp.

50° 08'47"N,
82° 08'24"W.



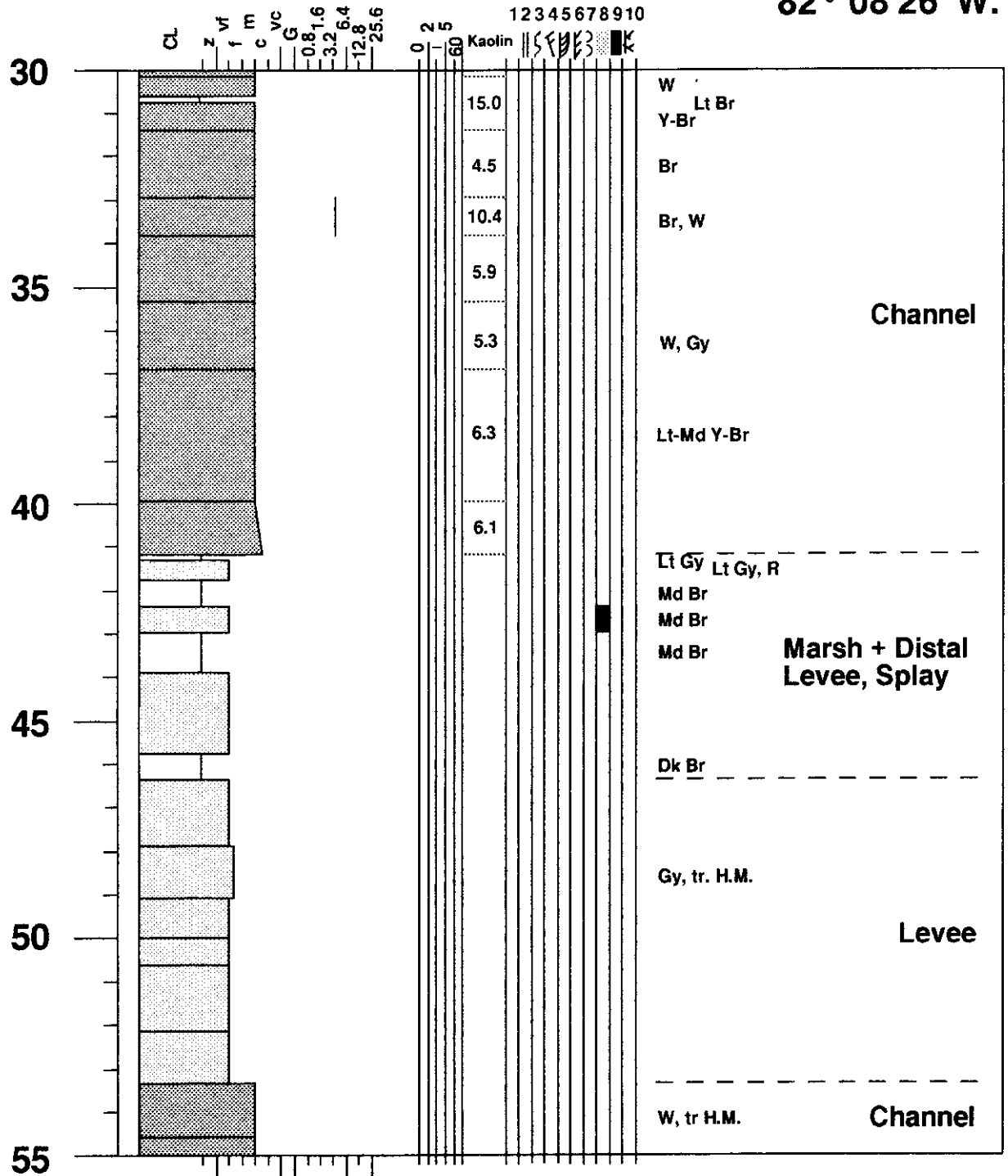
MRC hole 89 - 62, Kipling Twp.

50° 08'40"N,
82° 08'26"W.



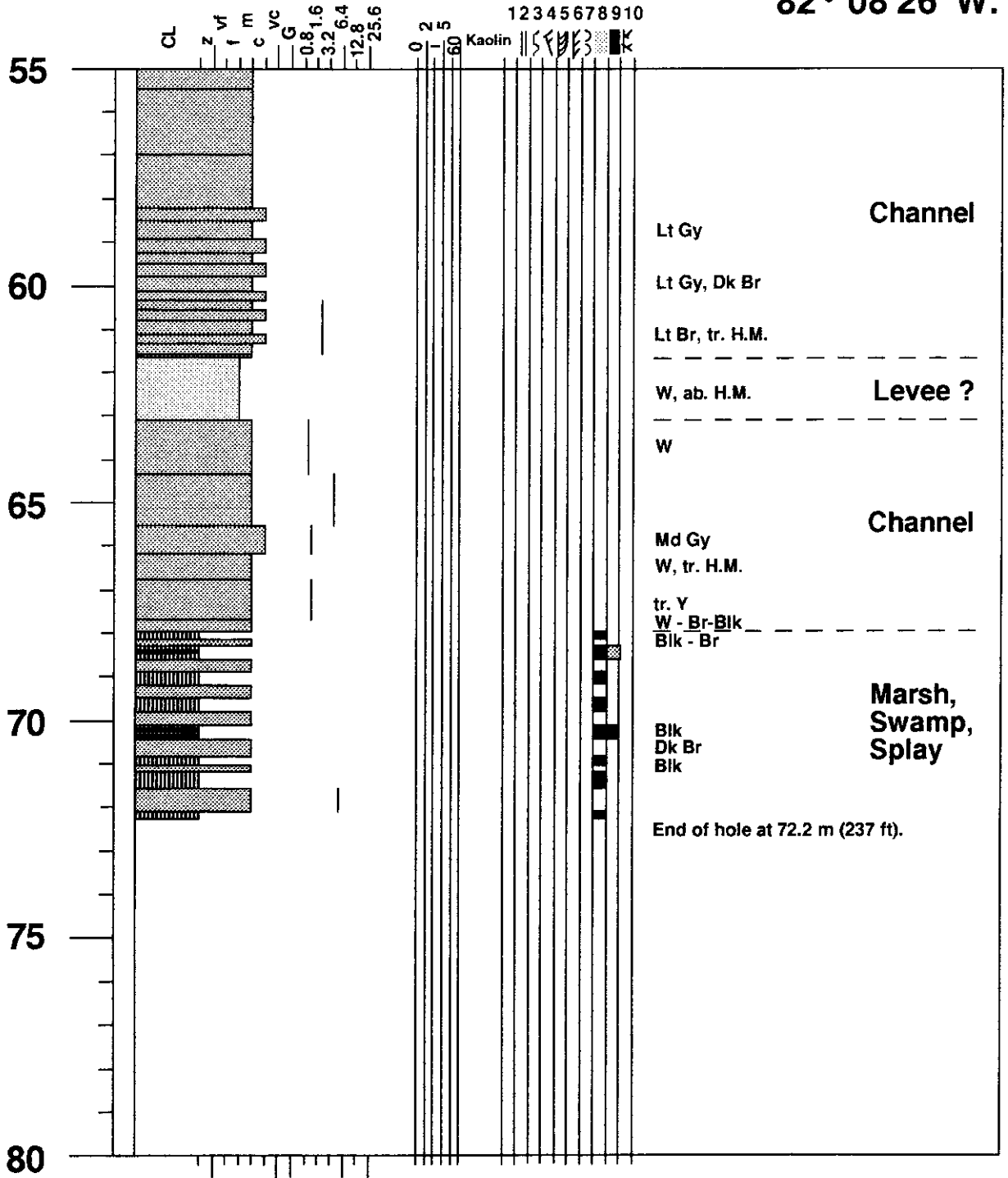
MRC hole 89 - 62, Kipling Twp.

50° 08'40"N,
82° 08'26"W.



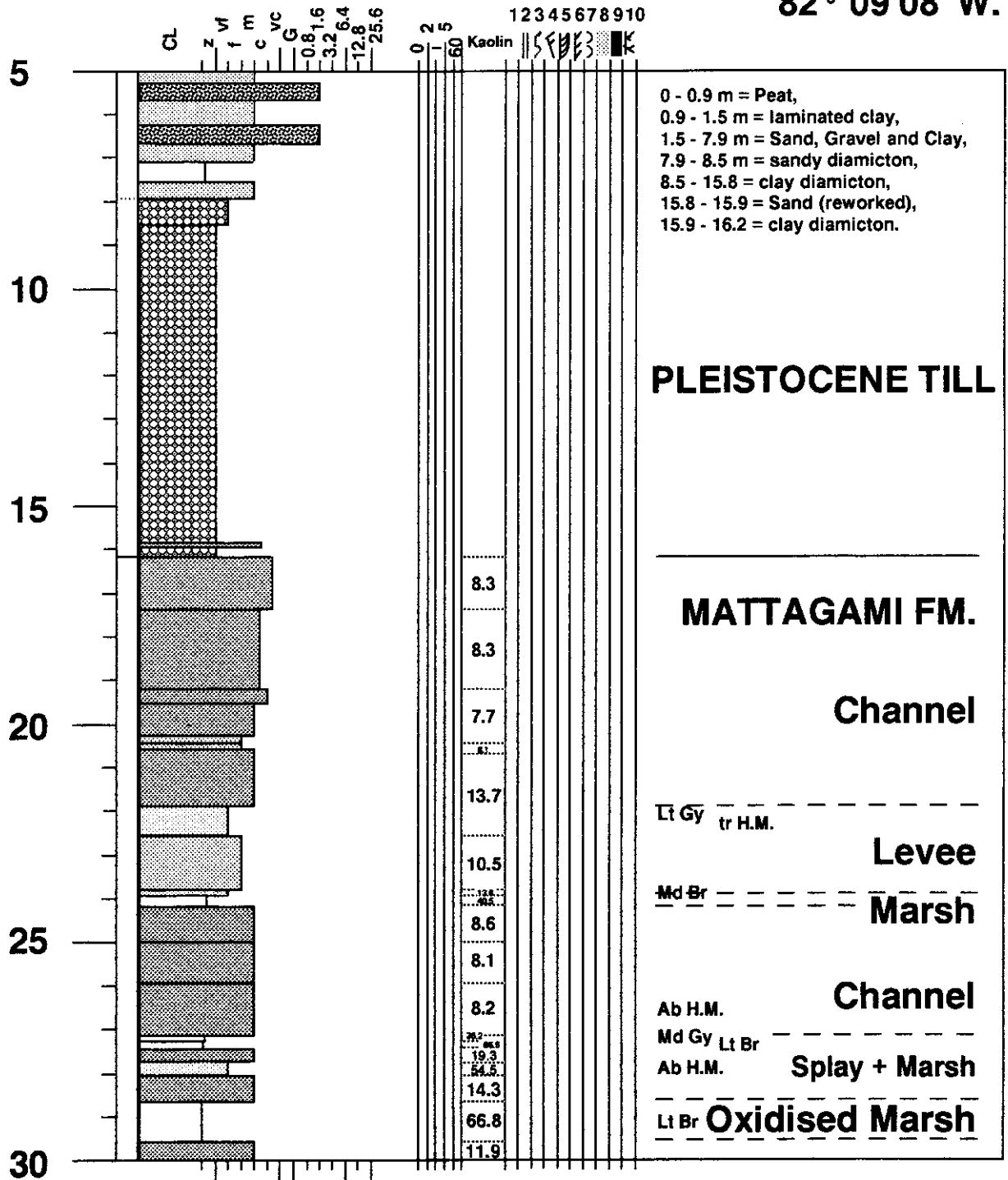
MRC hole 89 - 62, Kipling Twp.

50° 08'40"N,
82° 08'26"W.



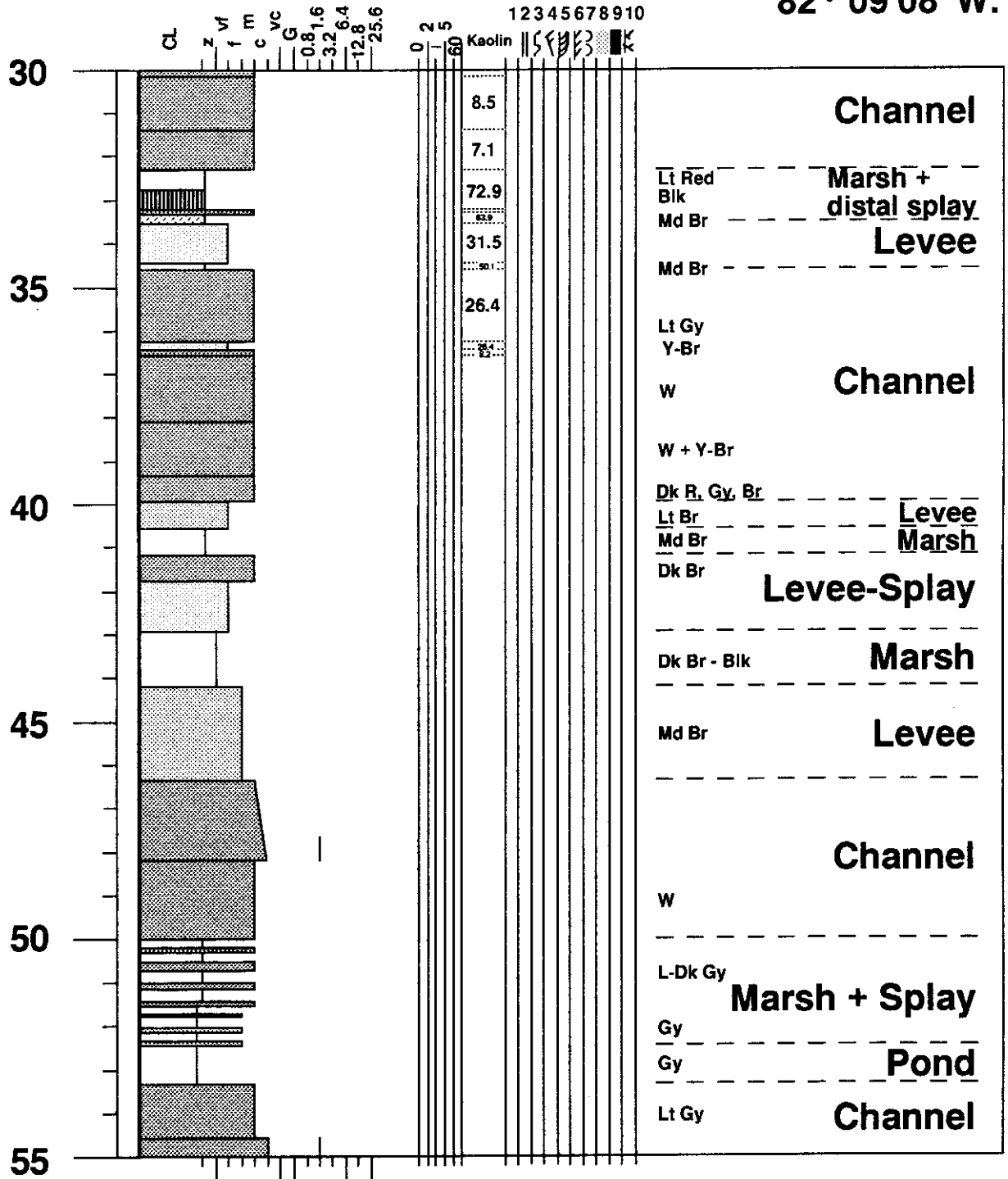
MRC hole 89 - 63, Kipling Twp.

50° 08'50"N,
82° 09'08"W.



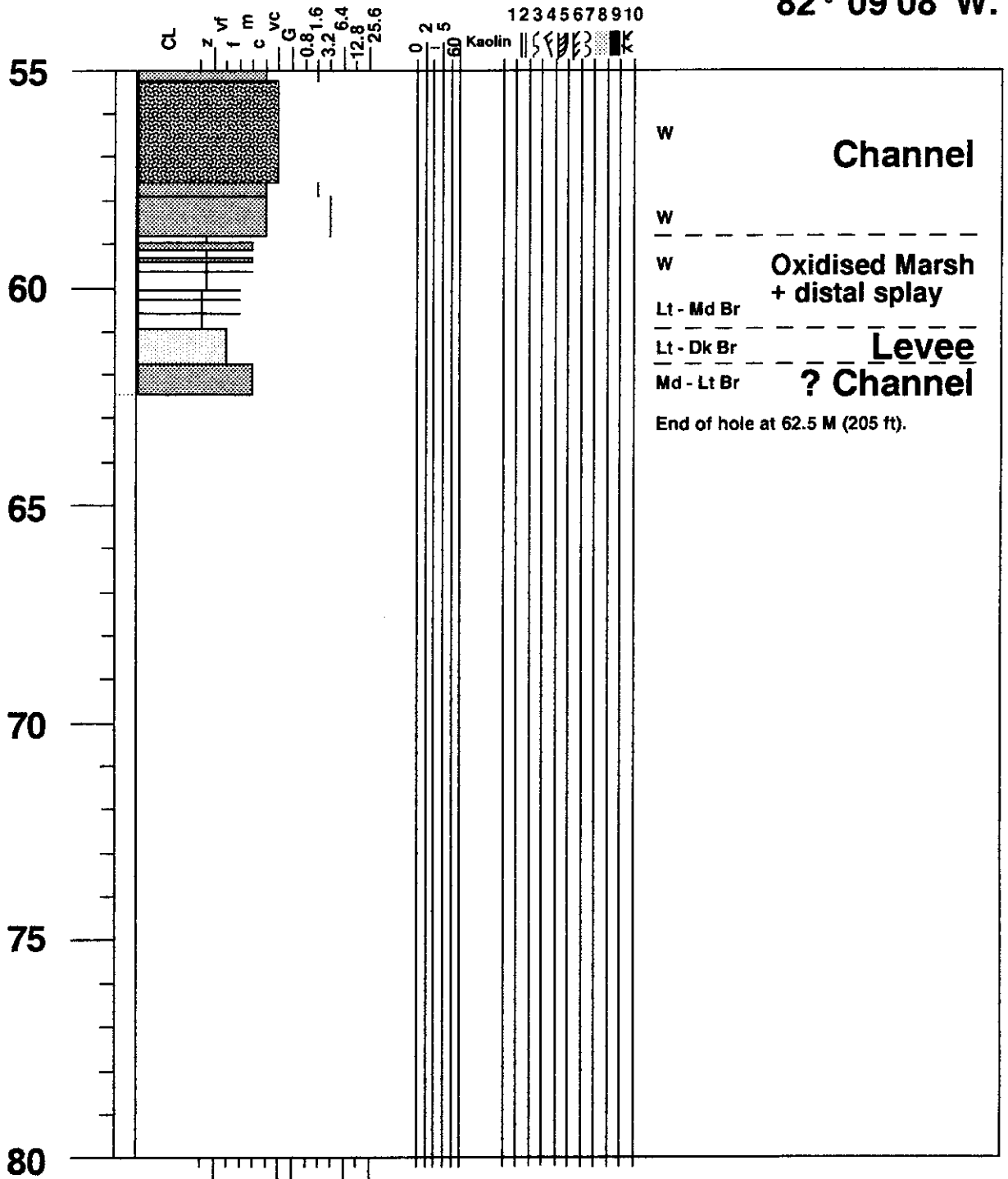
MRC hole 89 - 63, Kipling Twp.

50° 08'50"N,
82° 09'08"W.



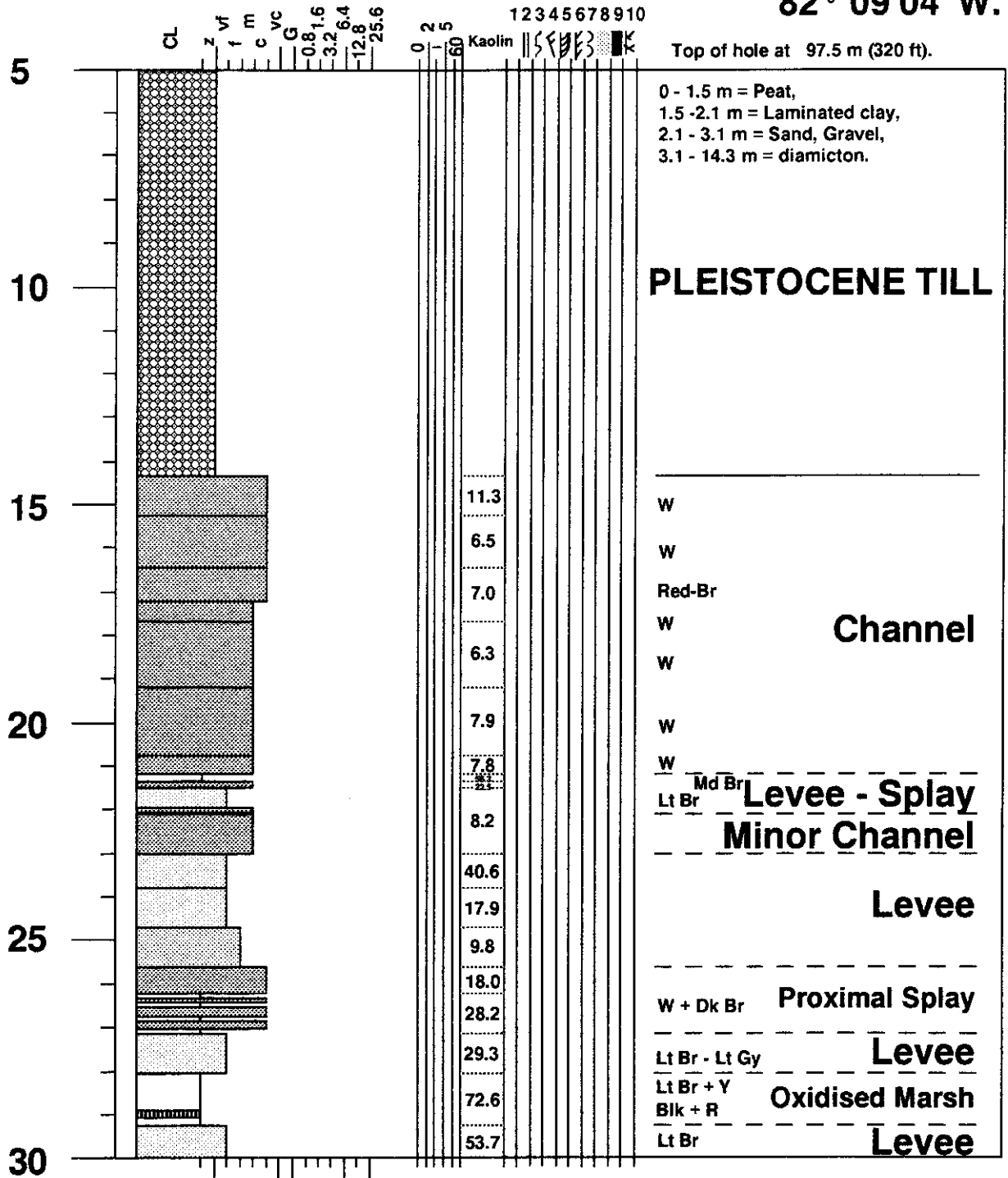
MRC hole 89 - 63, Kipling Twp.

50° 08'50"N,
82° 09'08"W.



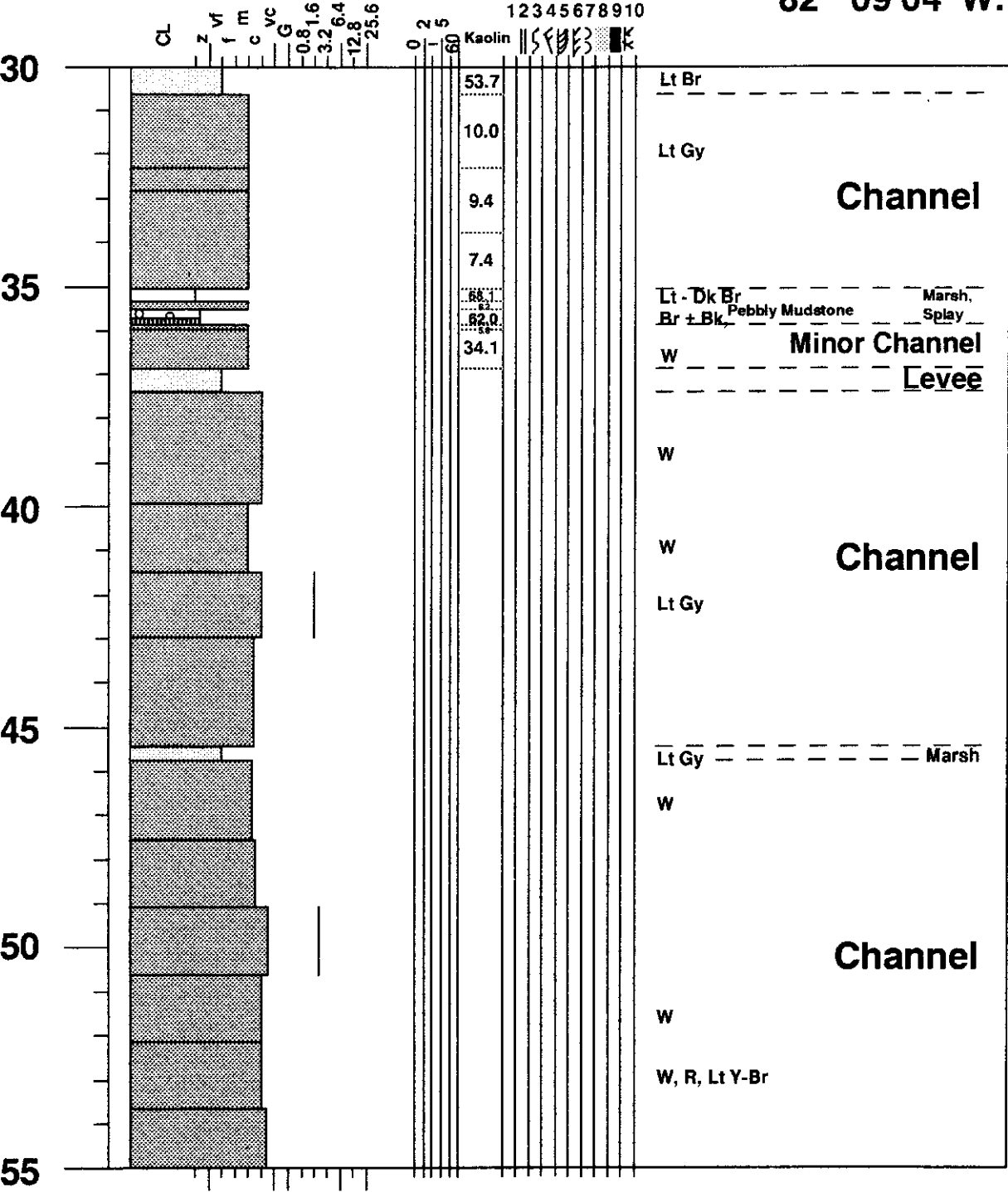
MRC hole 89 - 64, Kipling Twp.

50° 08'50"N,
82° 09'04"W.



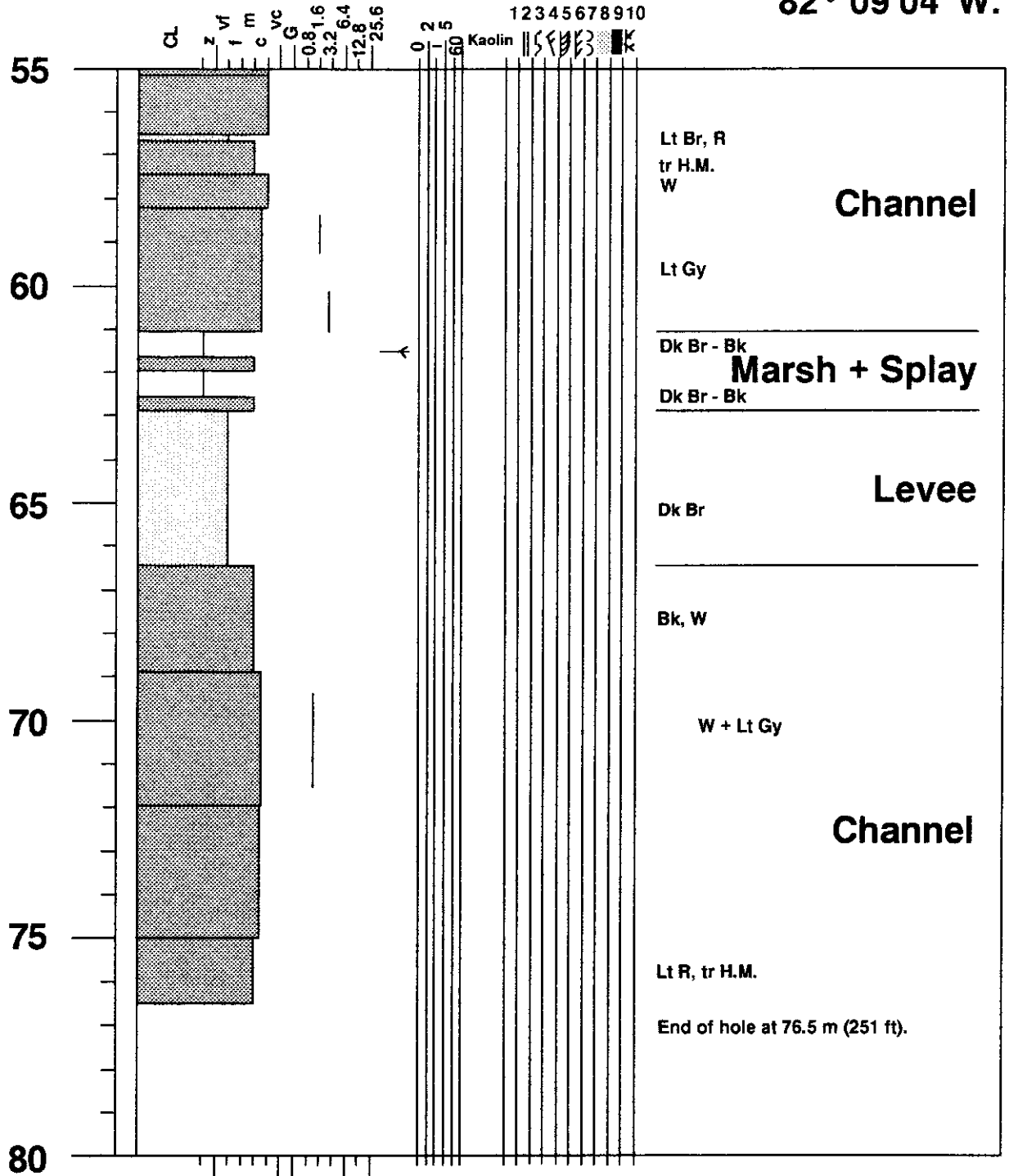
MRC hole 89 - 64, Kipling Twp.

50° 08'50"N,
82° 09'04"W.



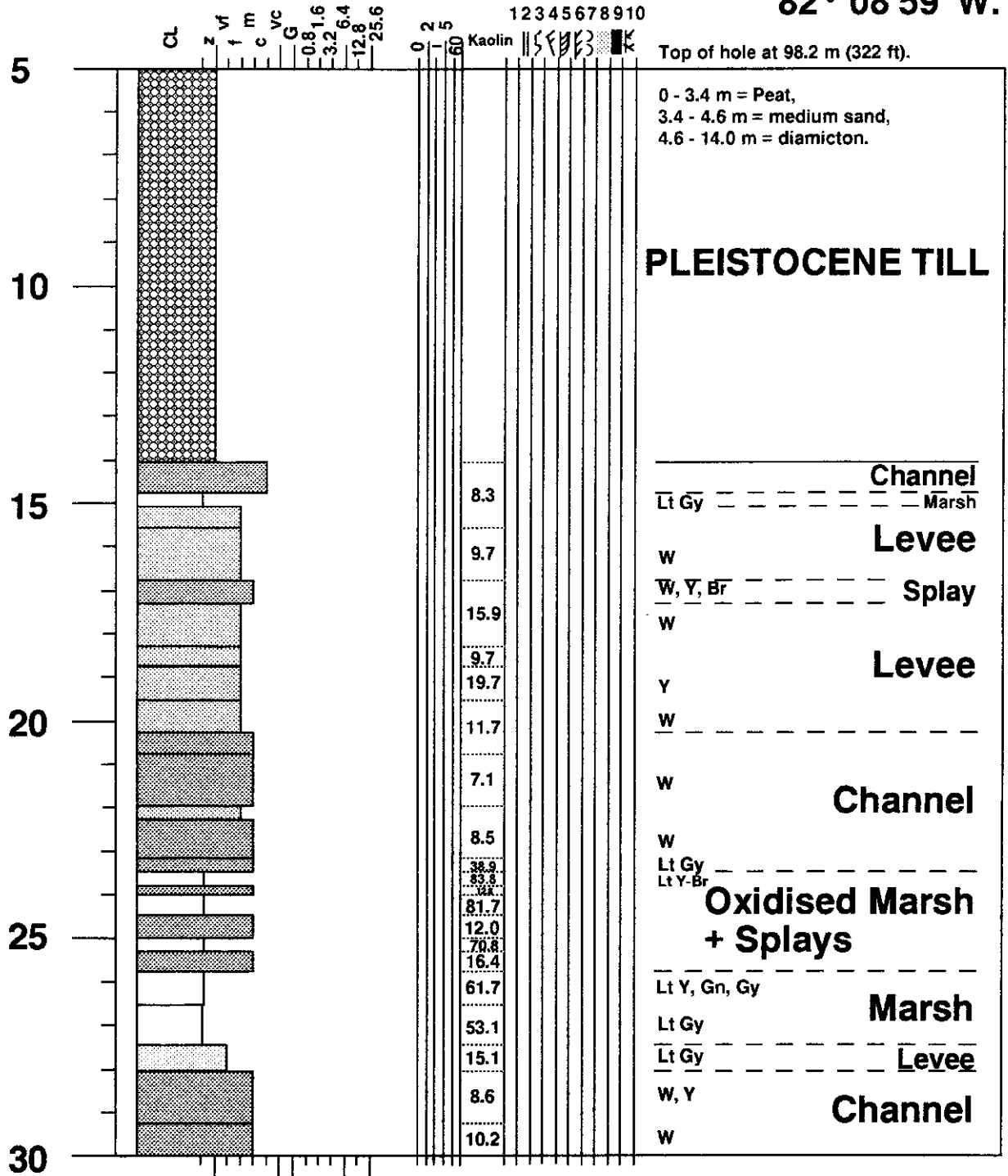
MRC hole 89 - 64, Kipling Twp.

50° 08'50"N,
82° 09'04"W.



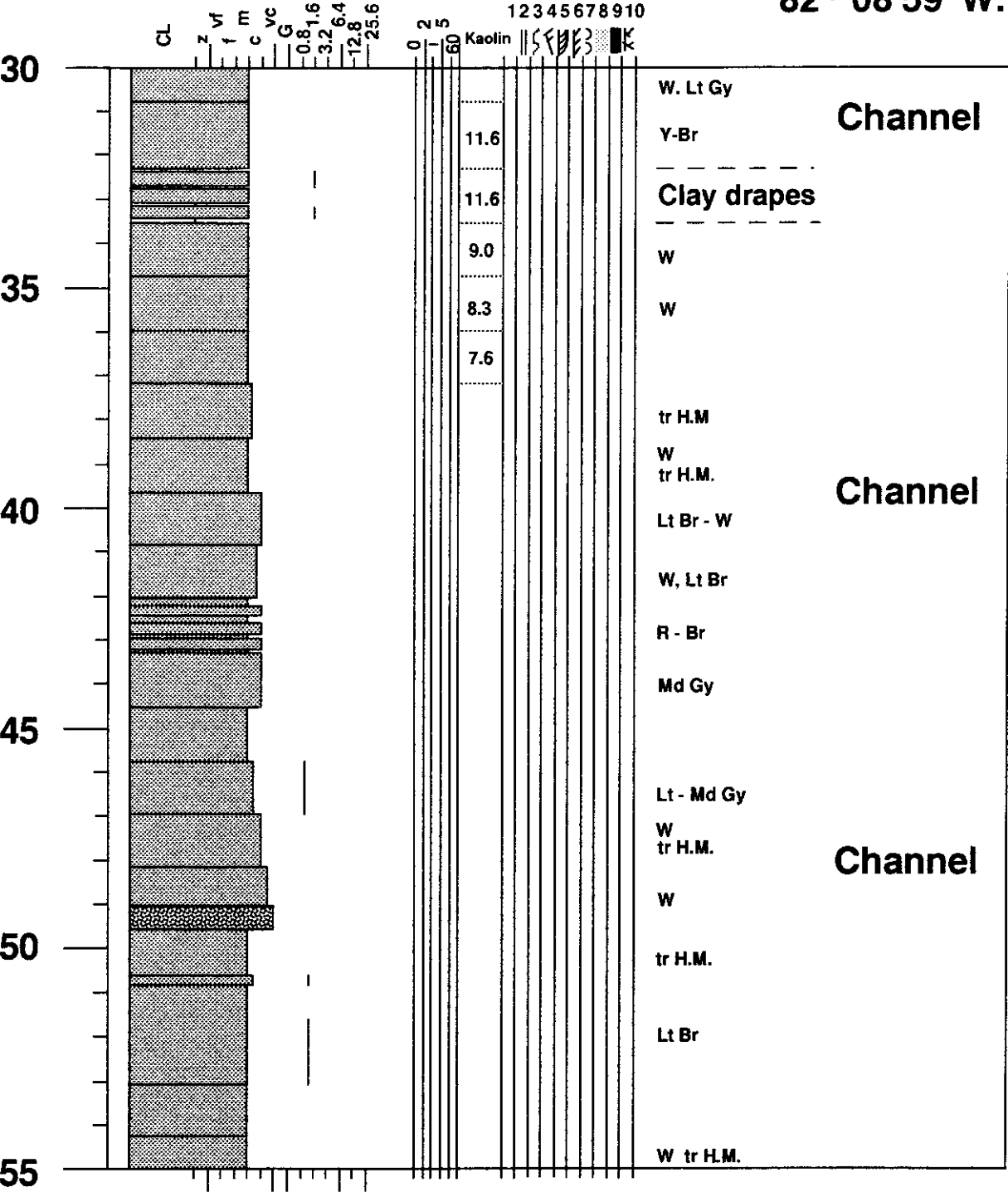
MRC hole 89 - 66, Kipling Twp.

50° 08'51"N,
82° 08'59"W.



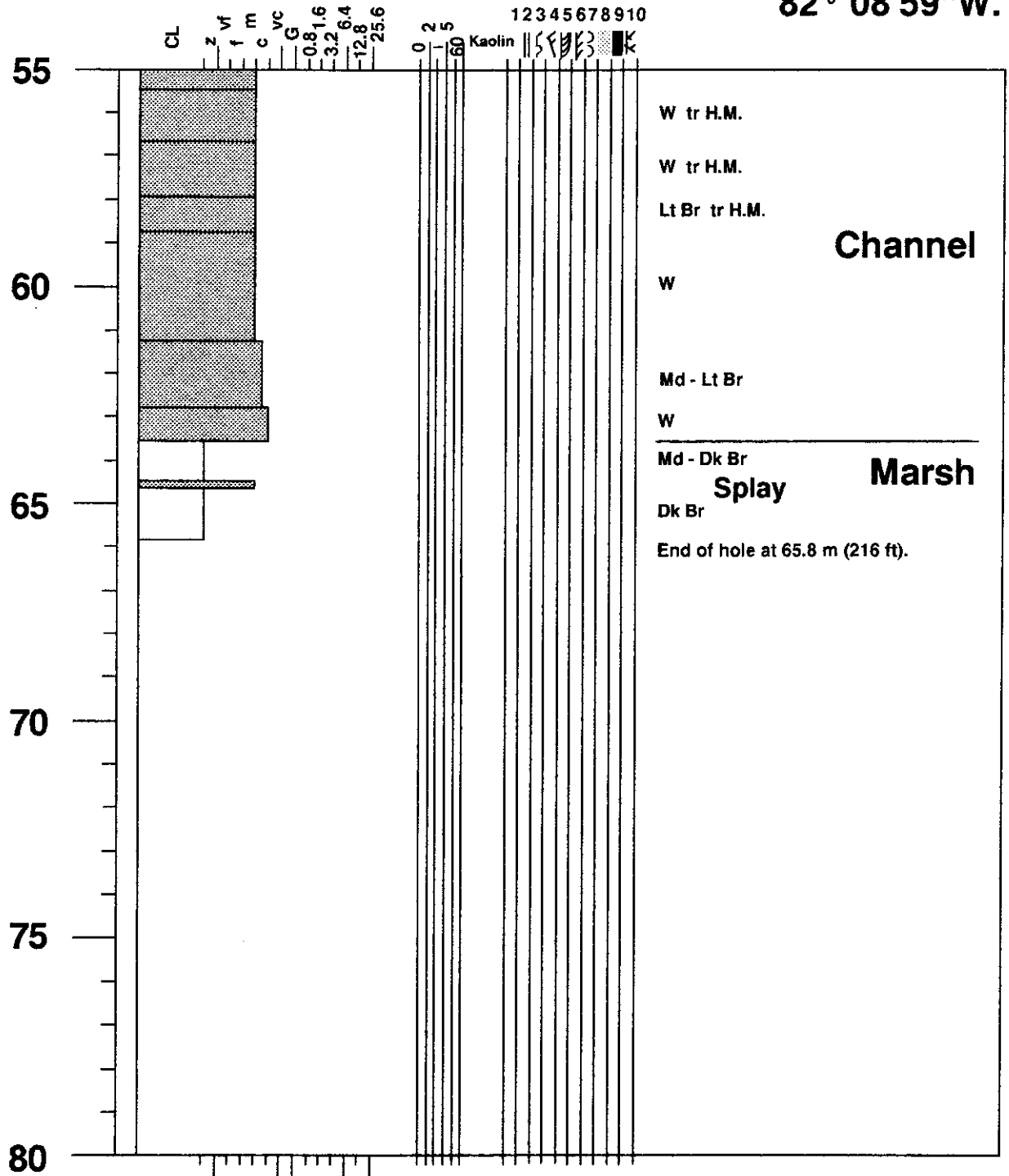
MRC hole 89 - 66, Kipling Twp.

50° 08'51"N,
82° 08'59"W.



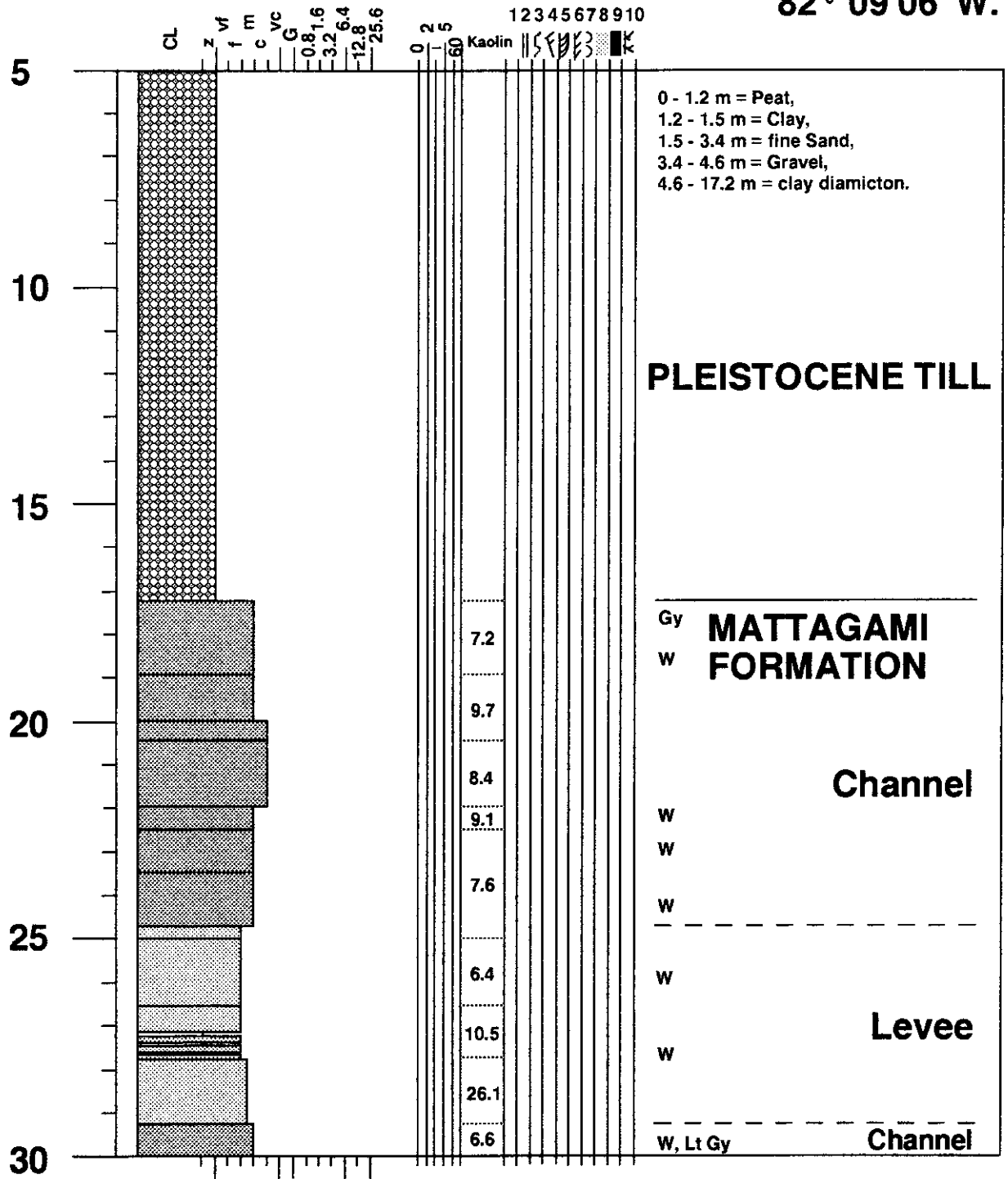
MRC hole 89 - 66, Kipling Twp.

50° 08'51"N,
82° 08'59"W.



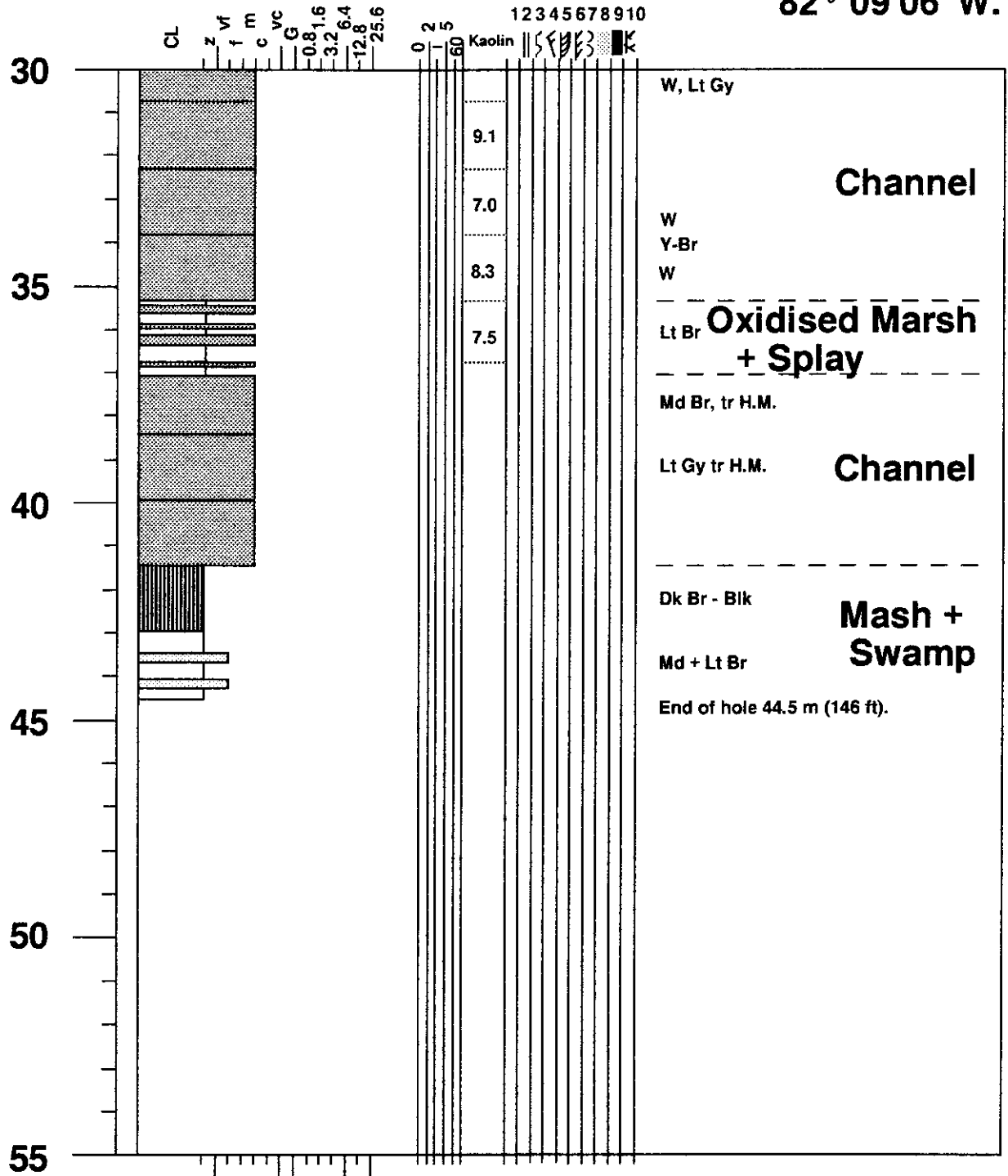
MRC hole 89 - 67, Kipling Twp.

50° 08'47"N,
82° 09'06"W.



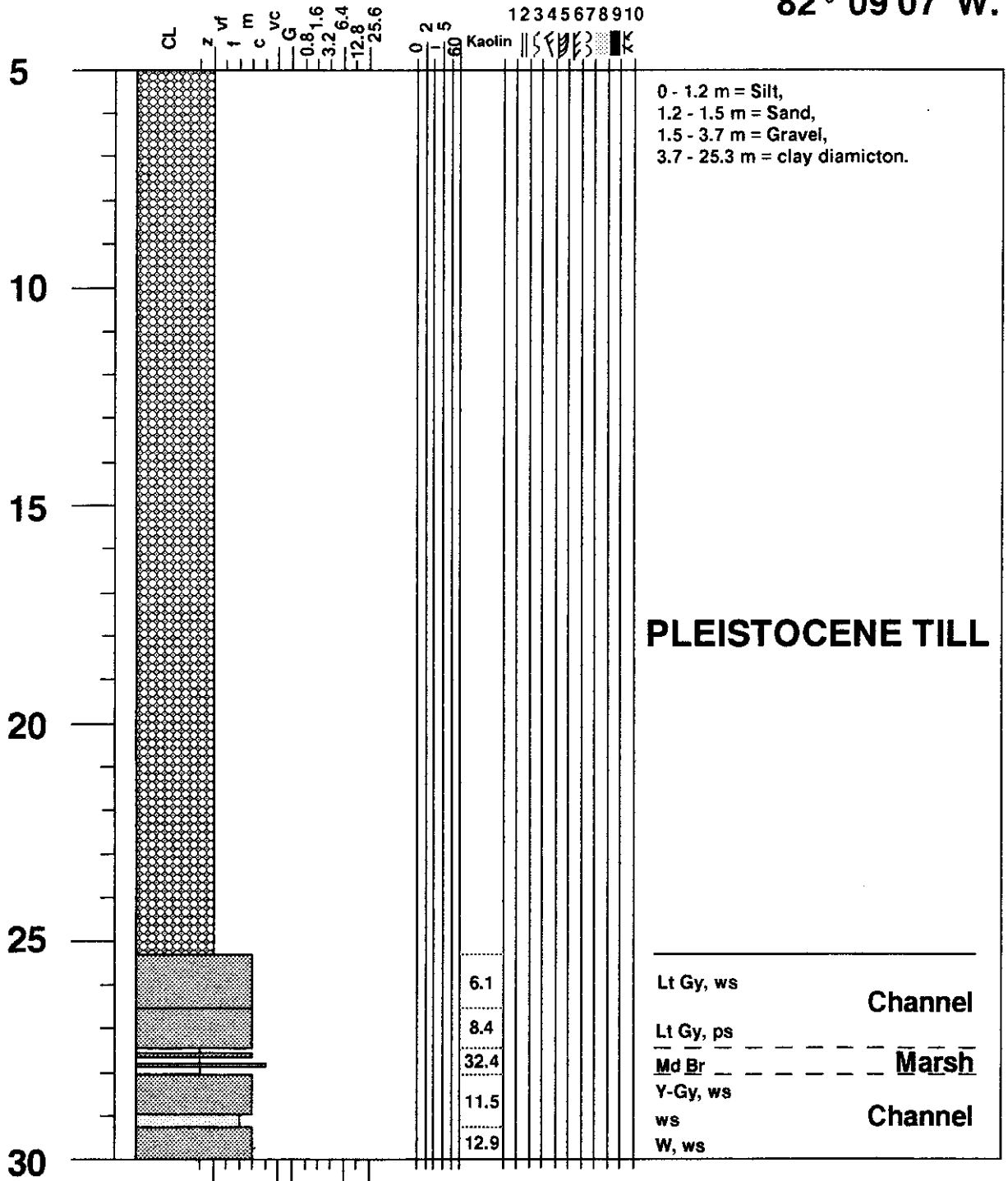
MRC hole 89 - 67, Kipling Twp.

50° 08'47"N,
82° 09'06"W.



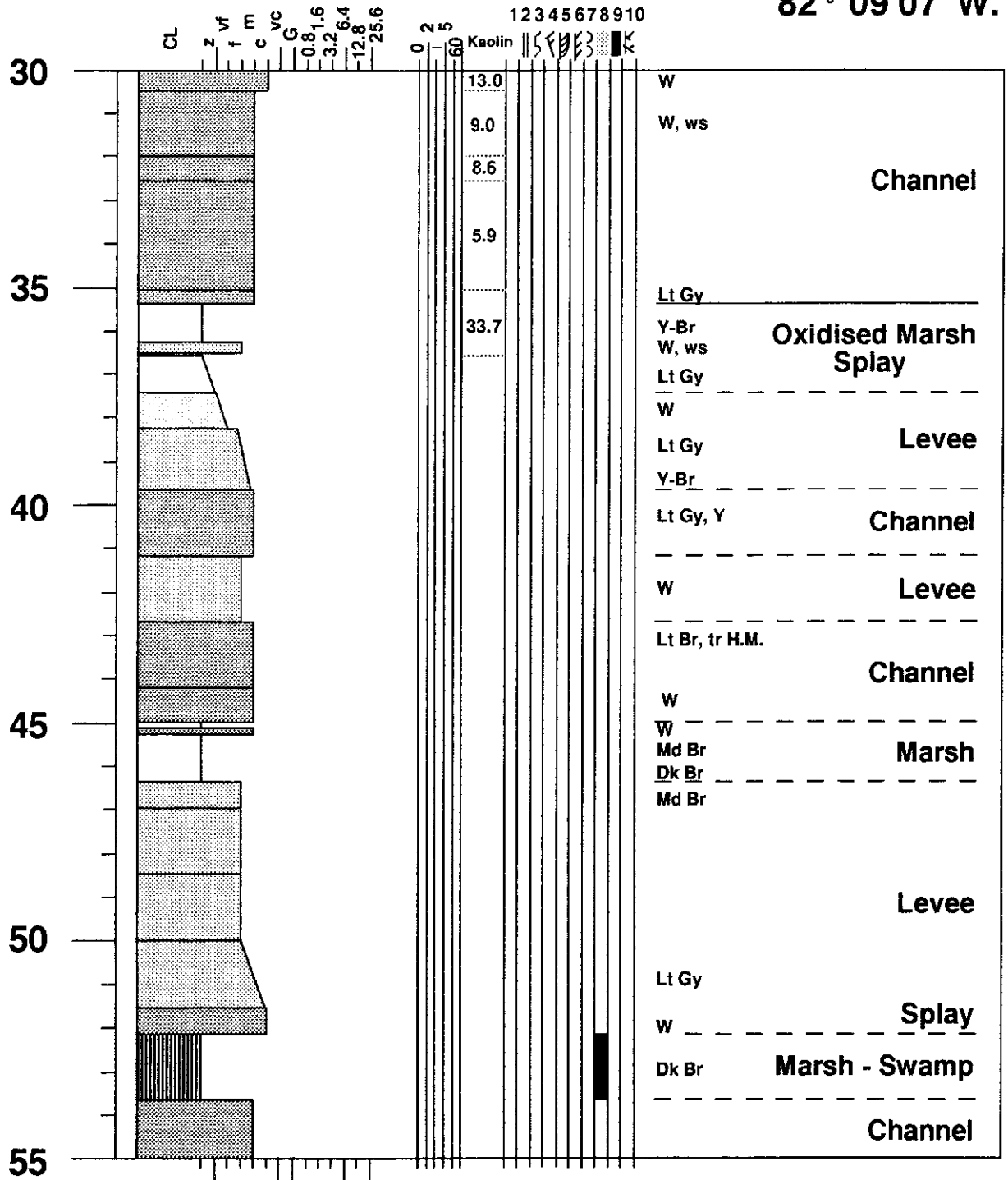
MRC hole 89 - 68, Kipling Twp.

50° 08'41"N,
82° 09'07"W.



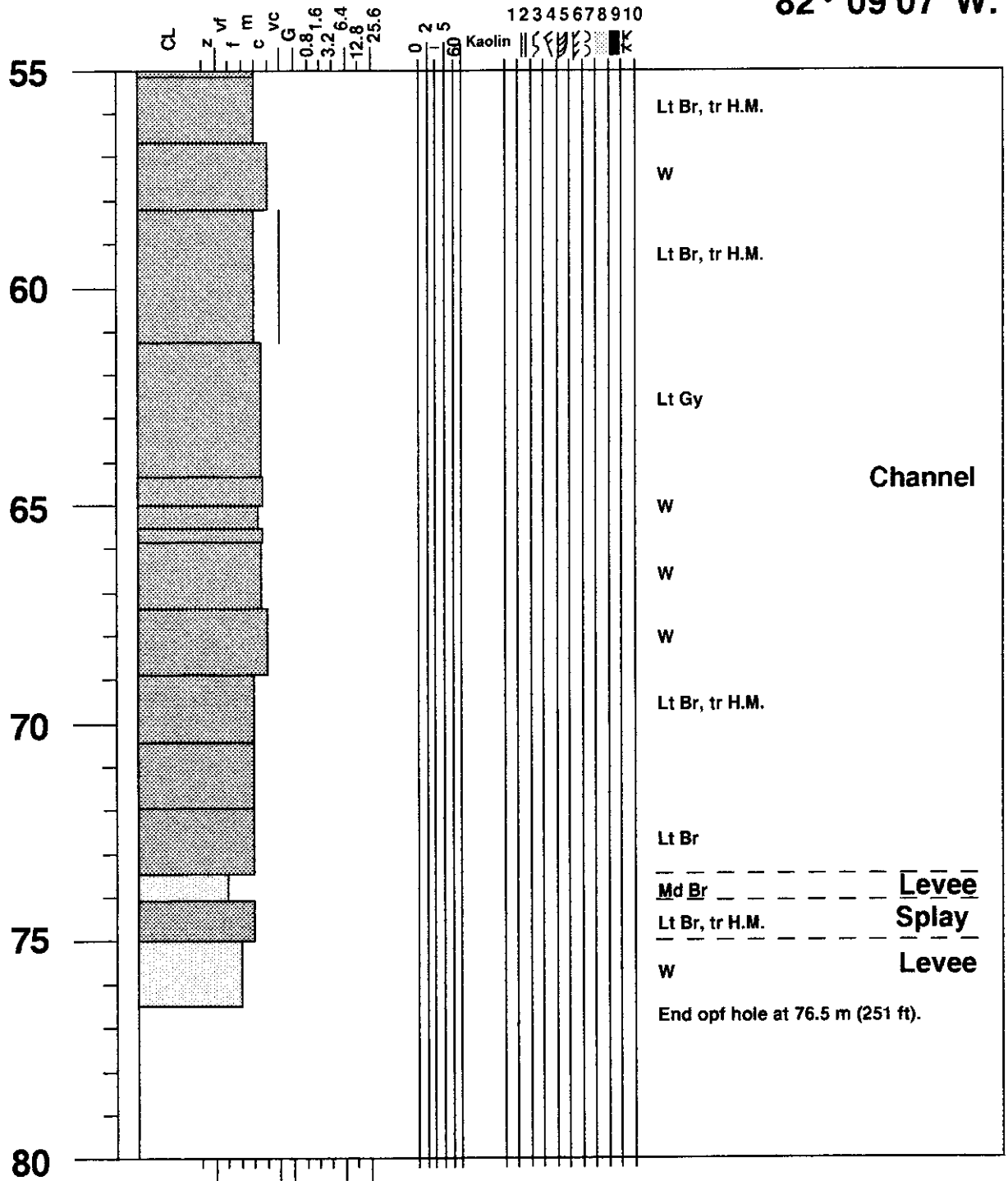
MRC hole 89 - 68, Kipling Twp.

50° 08'41"N,
82° 09'07"W.



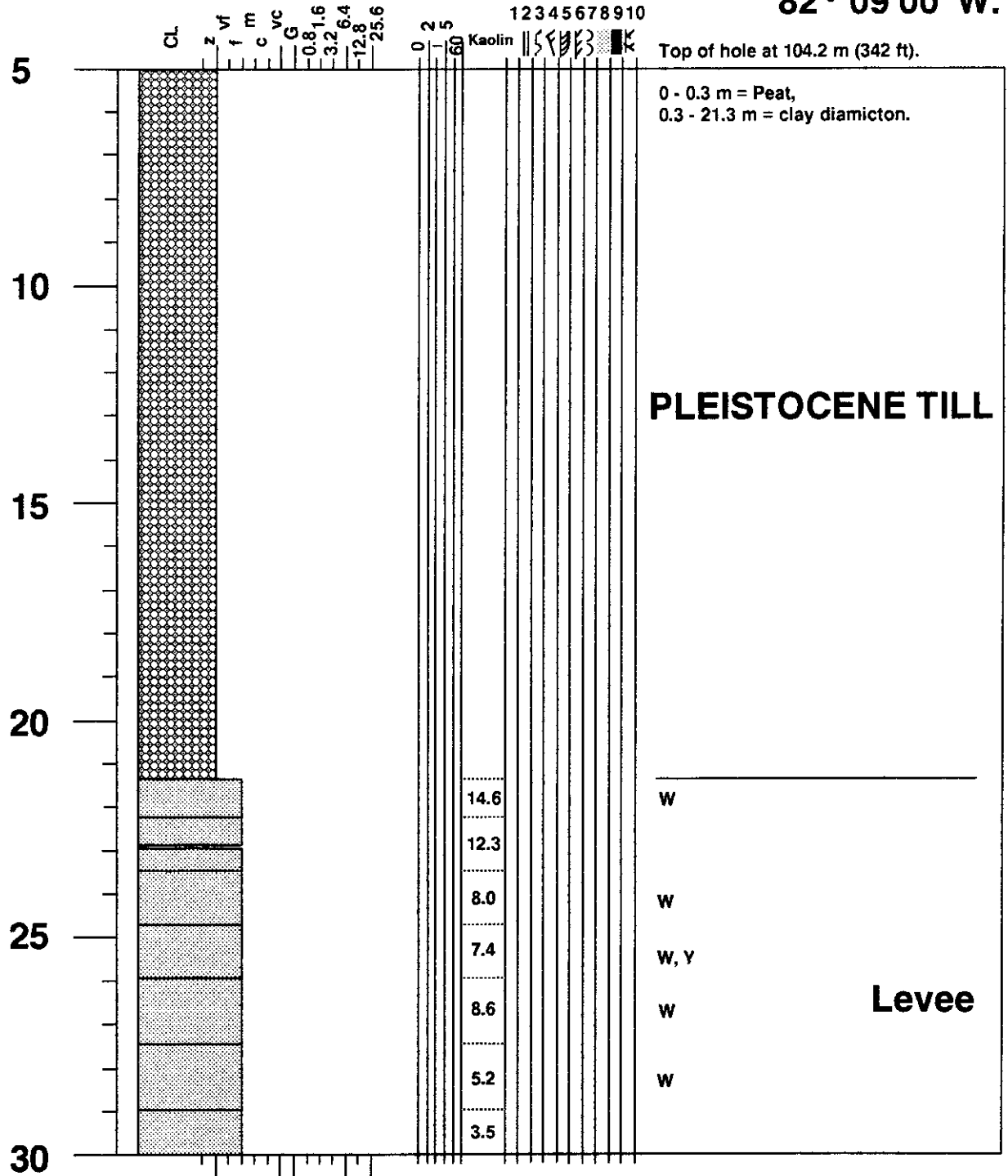
MRC hole 89 - 68, Kipling Twp.

50° 08'41"N,
82° 09'07"W.



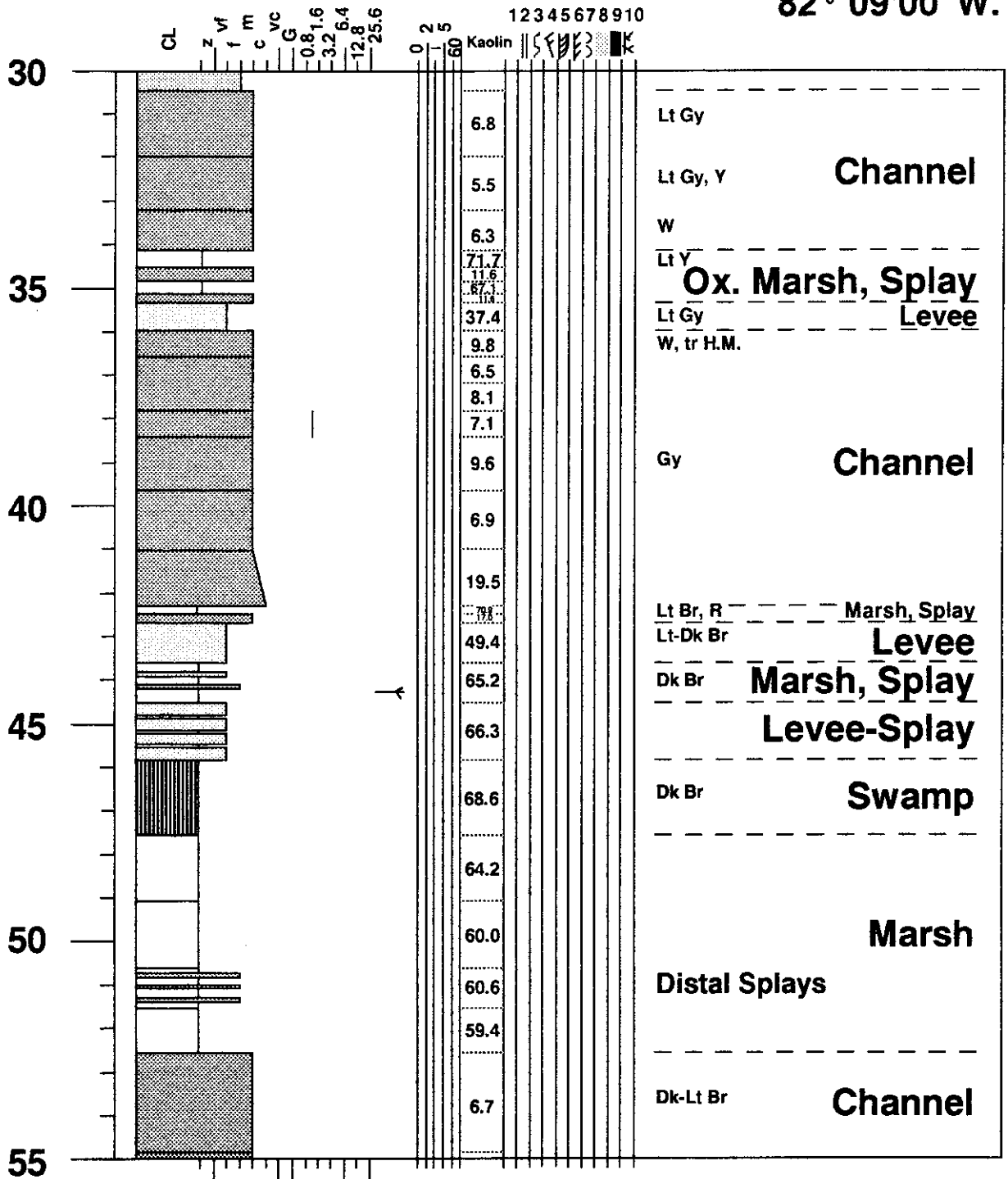
MRC hole 89 - 70, Kipling Twp.

50° 08'44"N,
82° 09'00"W.



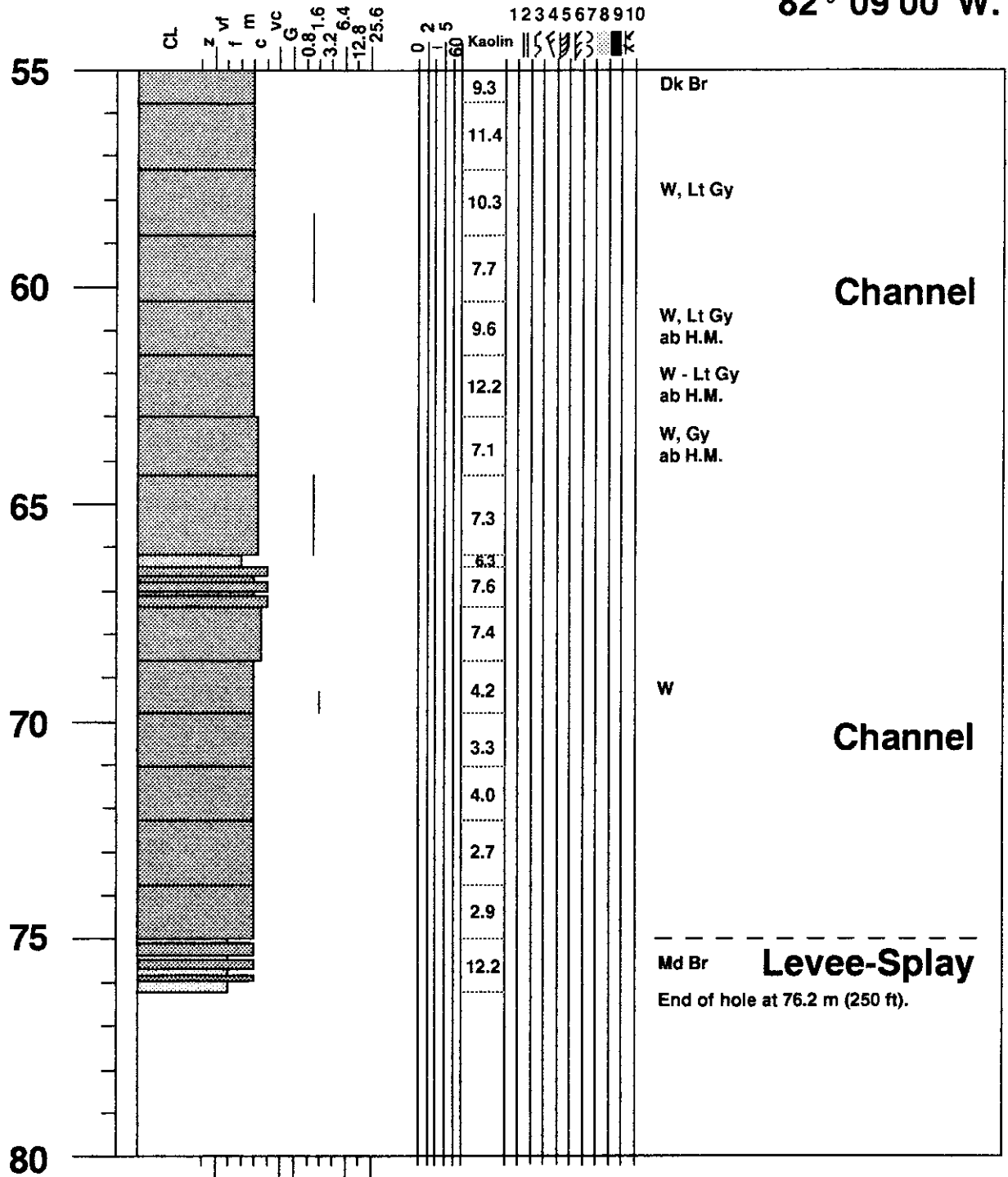
MRC hole 89 - 70, Kipling Twp.

50° 08'44"N,
82° 09'00"W.



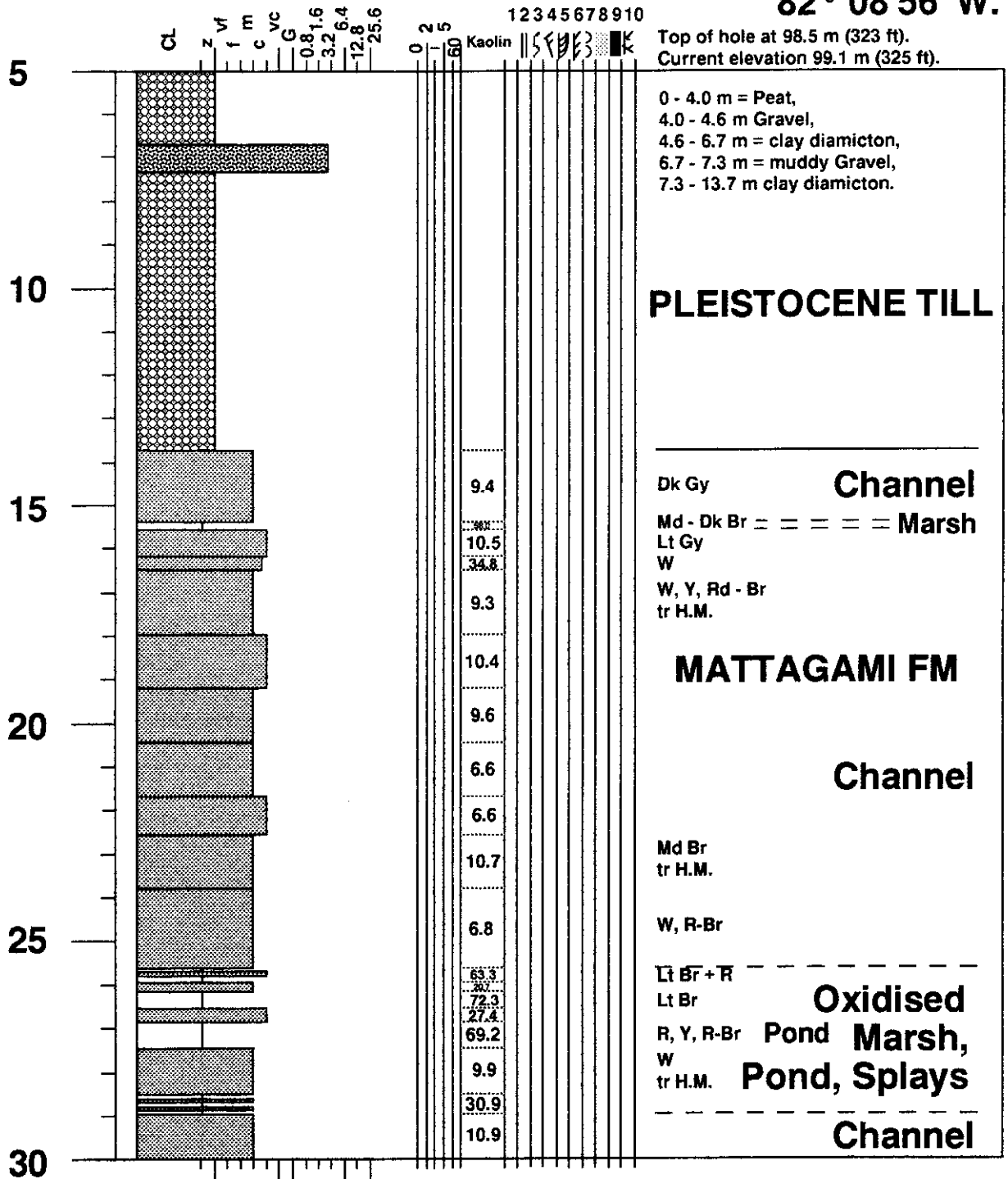
MRC hole 89 - 70, Kipling Twp.

50° 08'44"N,
82° 09'00"W.



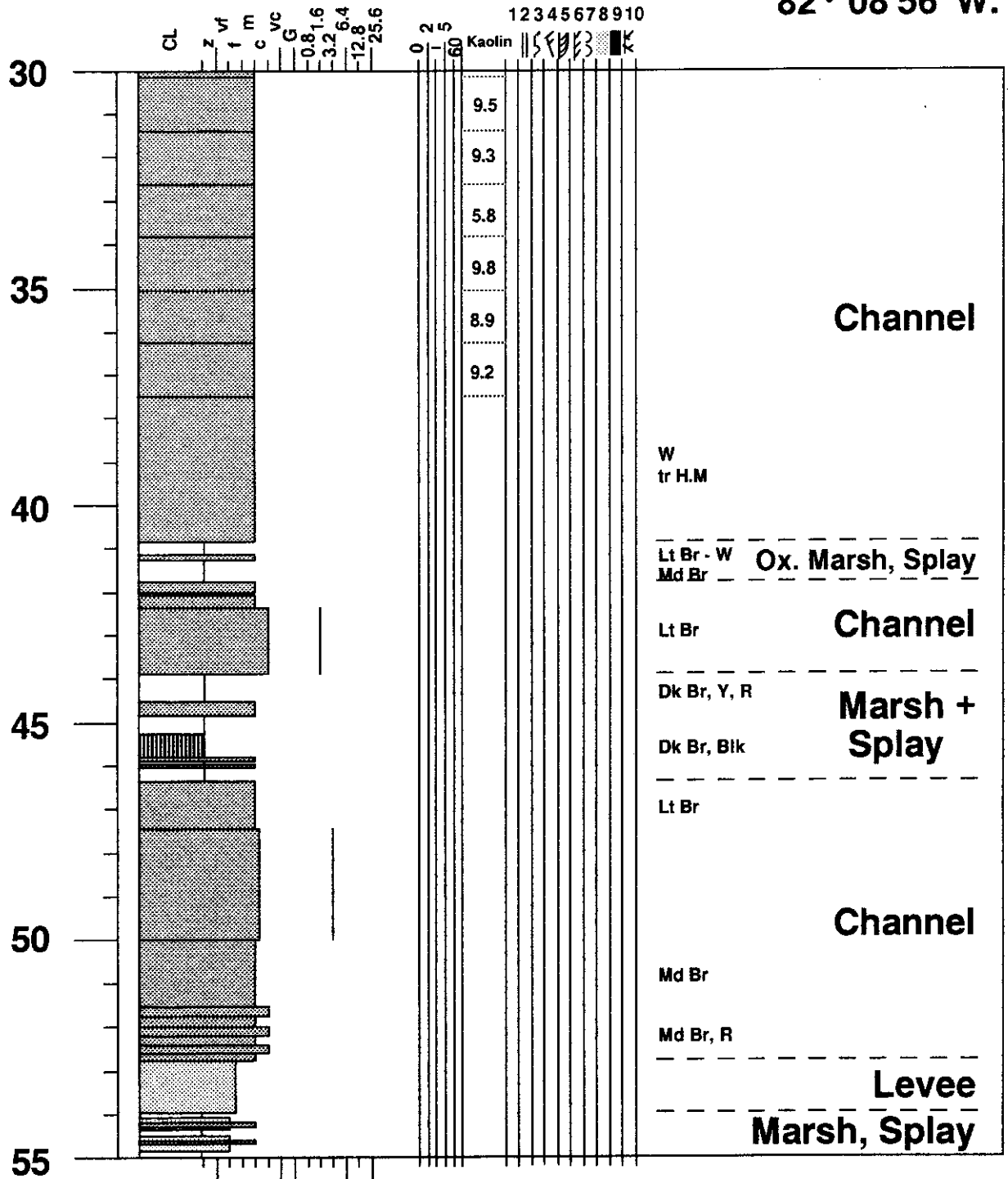
MRC hole 89 - 72, Kipling Twp.

50° 08'48"N,
82° 08'56"W.



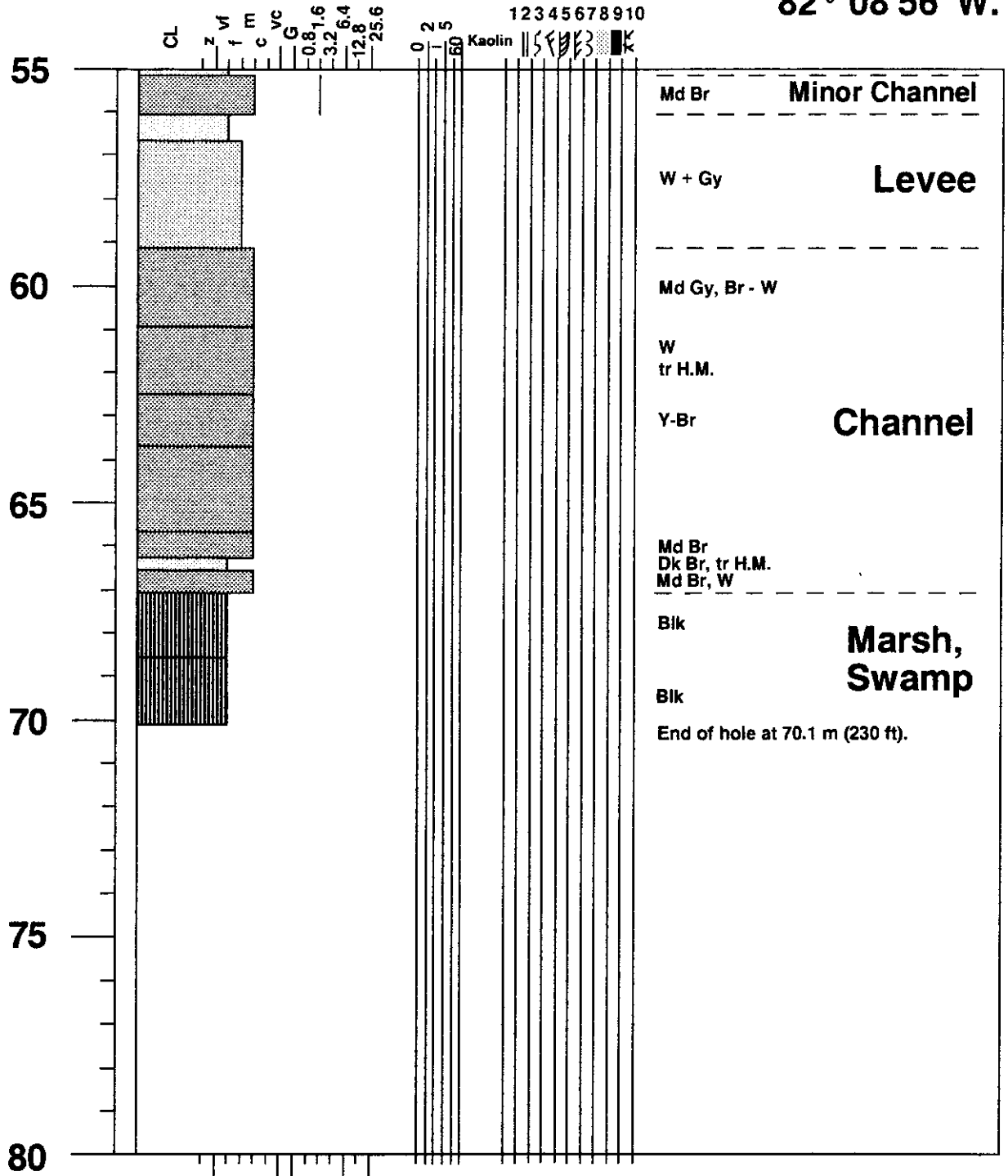
MRC hole 89 - 72, Kipling Twp.

50° 08'48"N,
82° 08'56"W.



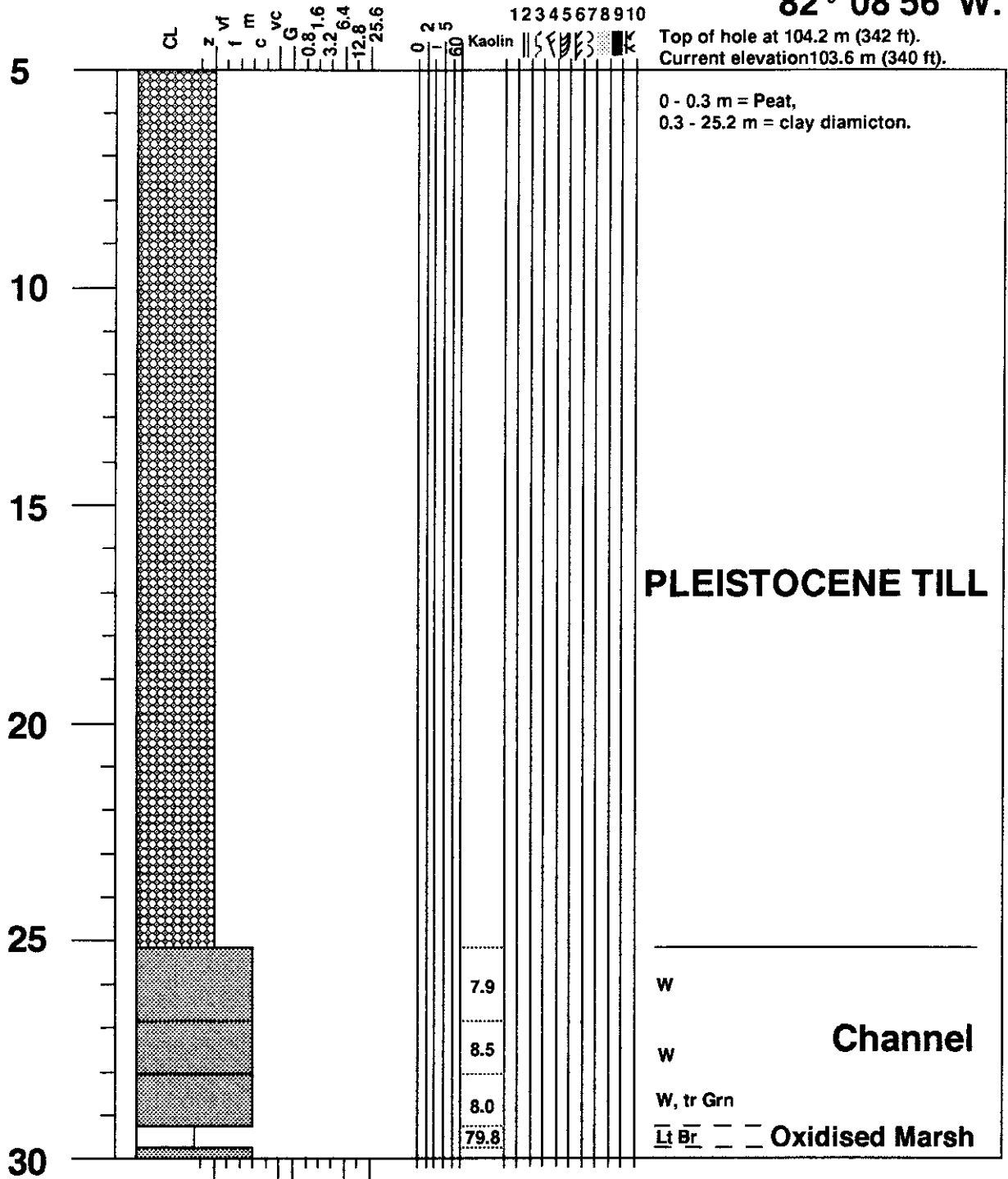
MRC hole 89 - 72, Kipling Twp.

50° 08'48"N,
82° 08'56"W.



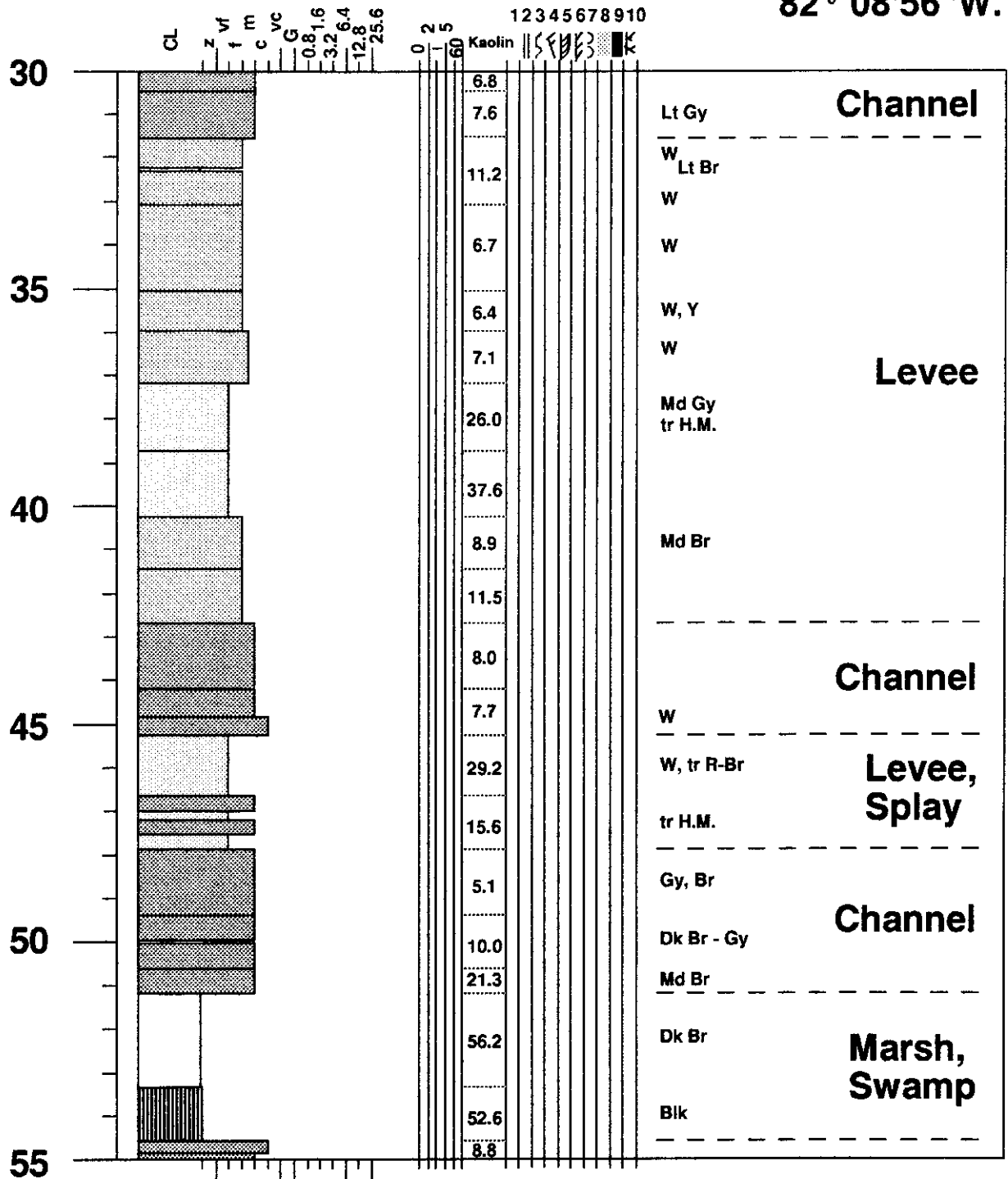
MRC hole 89 - 73, Kipling Twp.

50° 08'45"N,
82° 08'56"W.



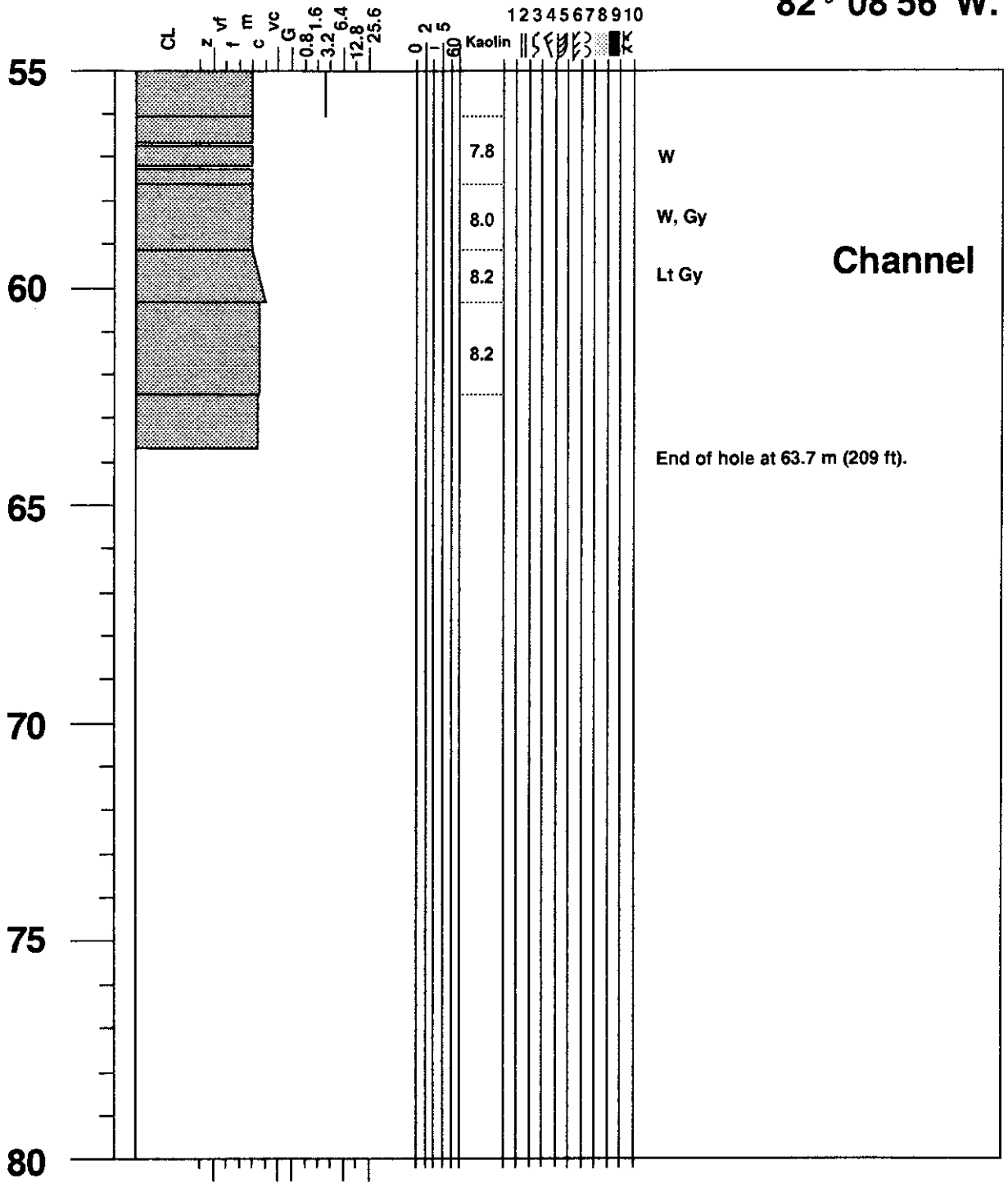
MRC hole 89 - 73, Kipling Twp.

50° 08'45"N,
82° 08'56"W.



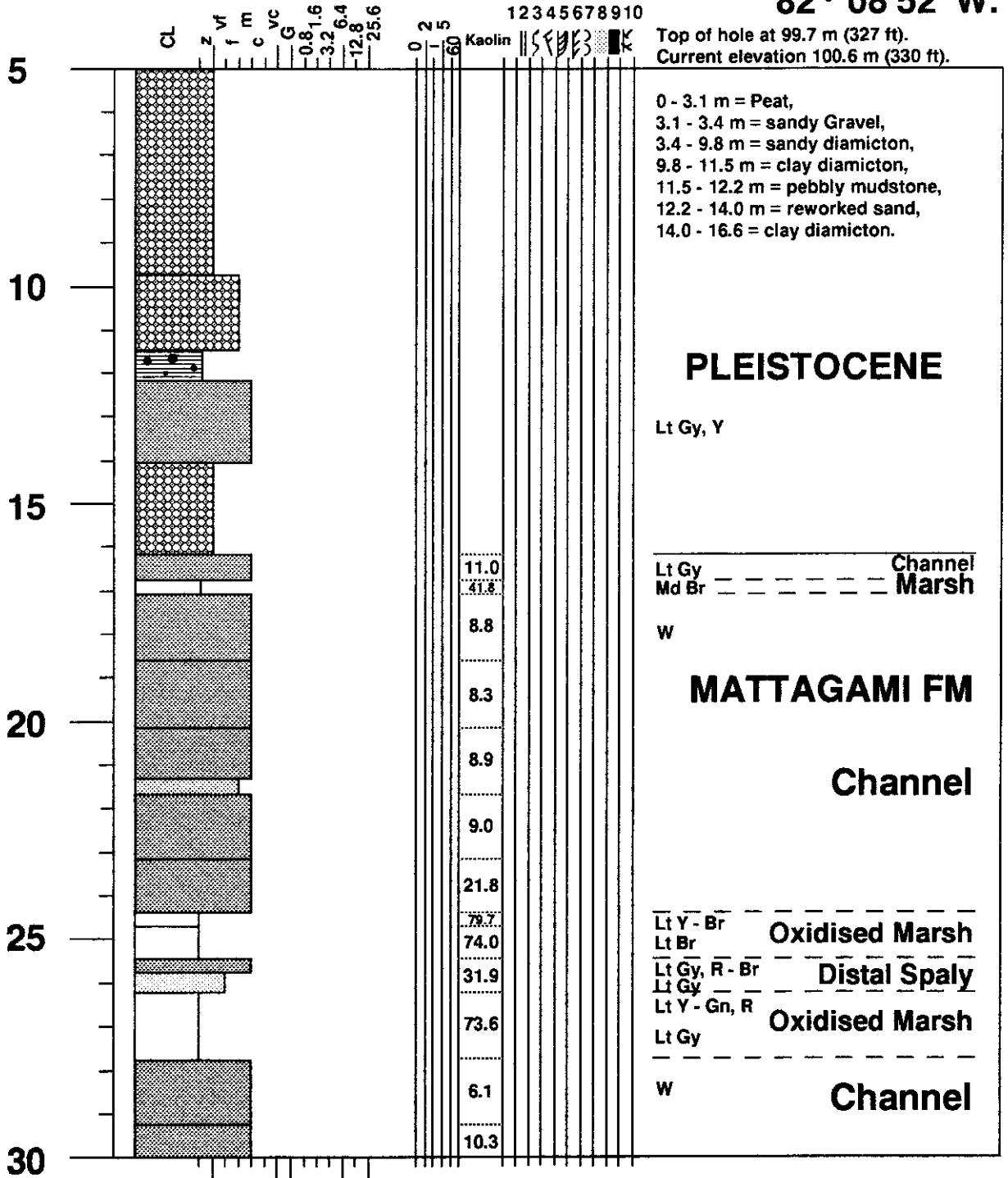
MRC hole 89 - 73, Kipling Twp.

50° 08'45"N,
82° 08'56"W.



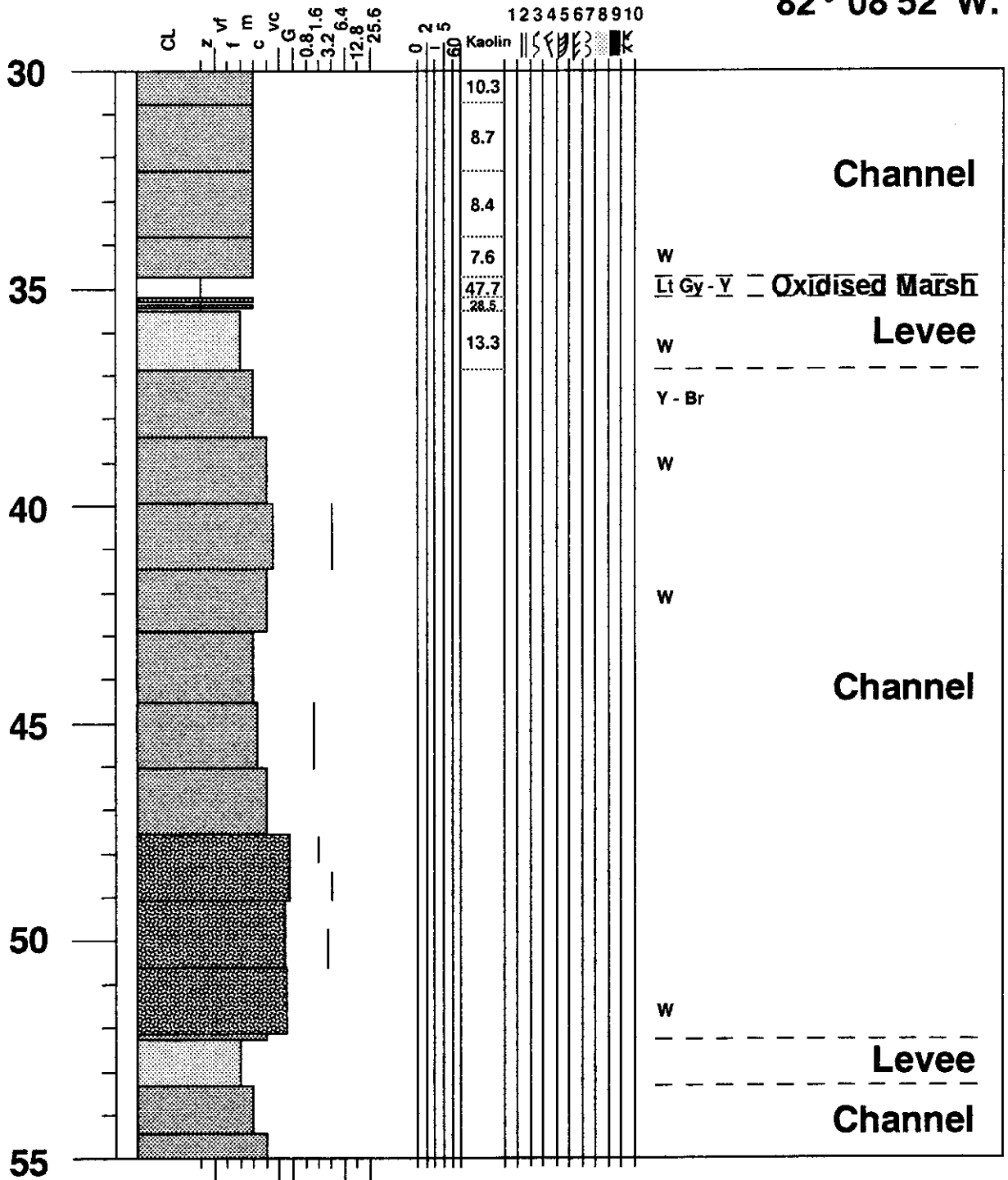
MRC hole 89 - 75, Kipling Twp.

50° 08'51"N,
82° 08'52"W.



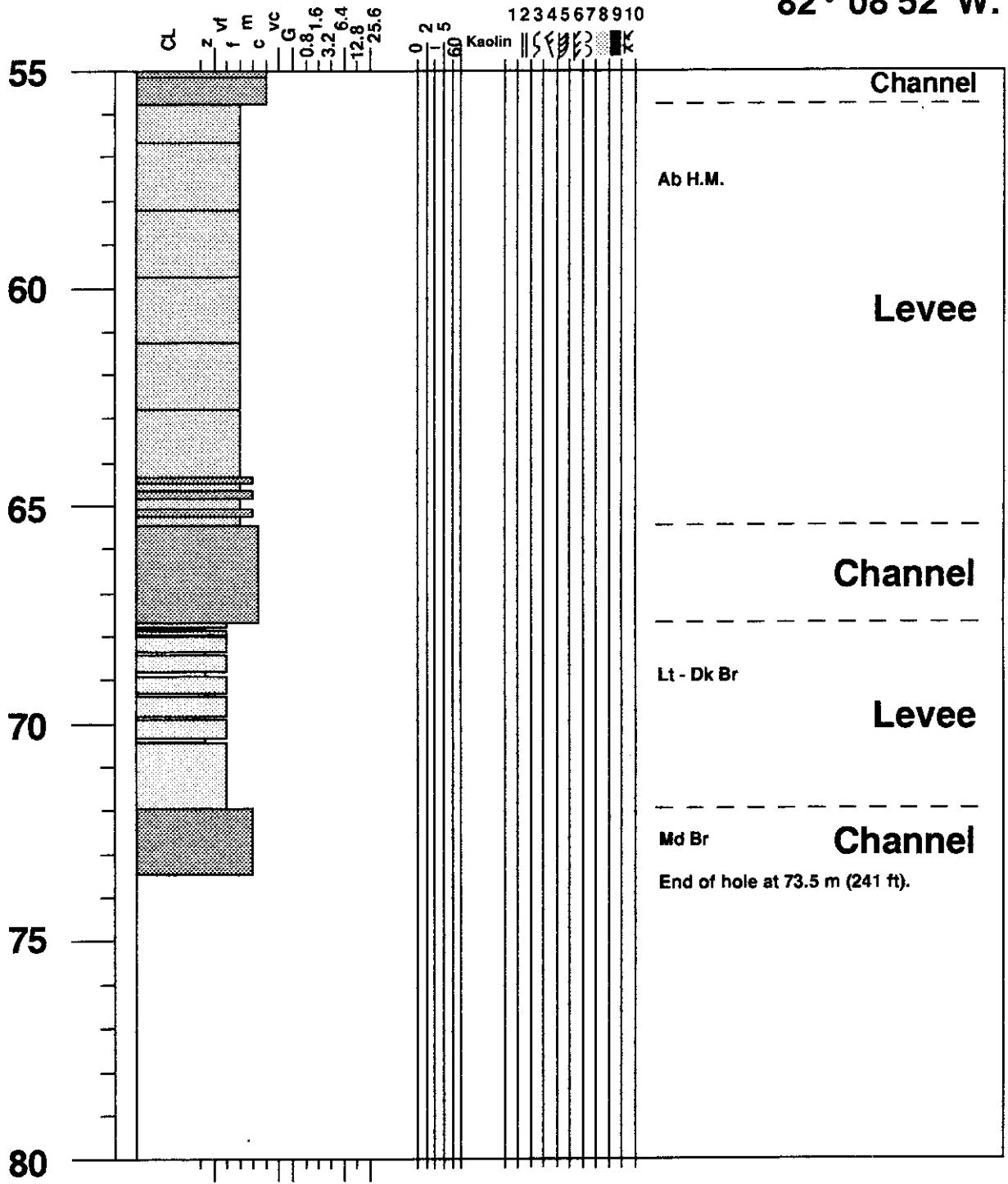
MRC hole 89 - 75, Kipling Twp.

50° 08'51"N,
82° 08'52"W.



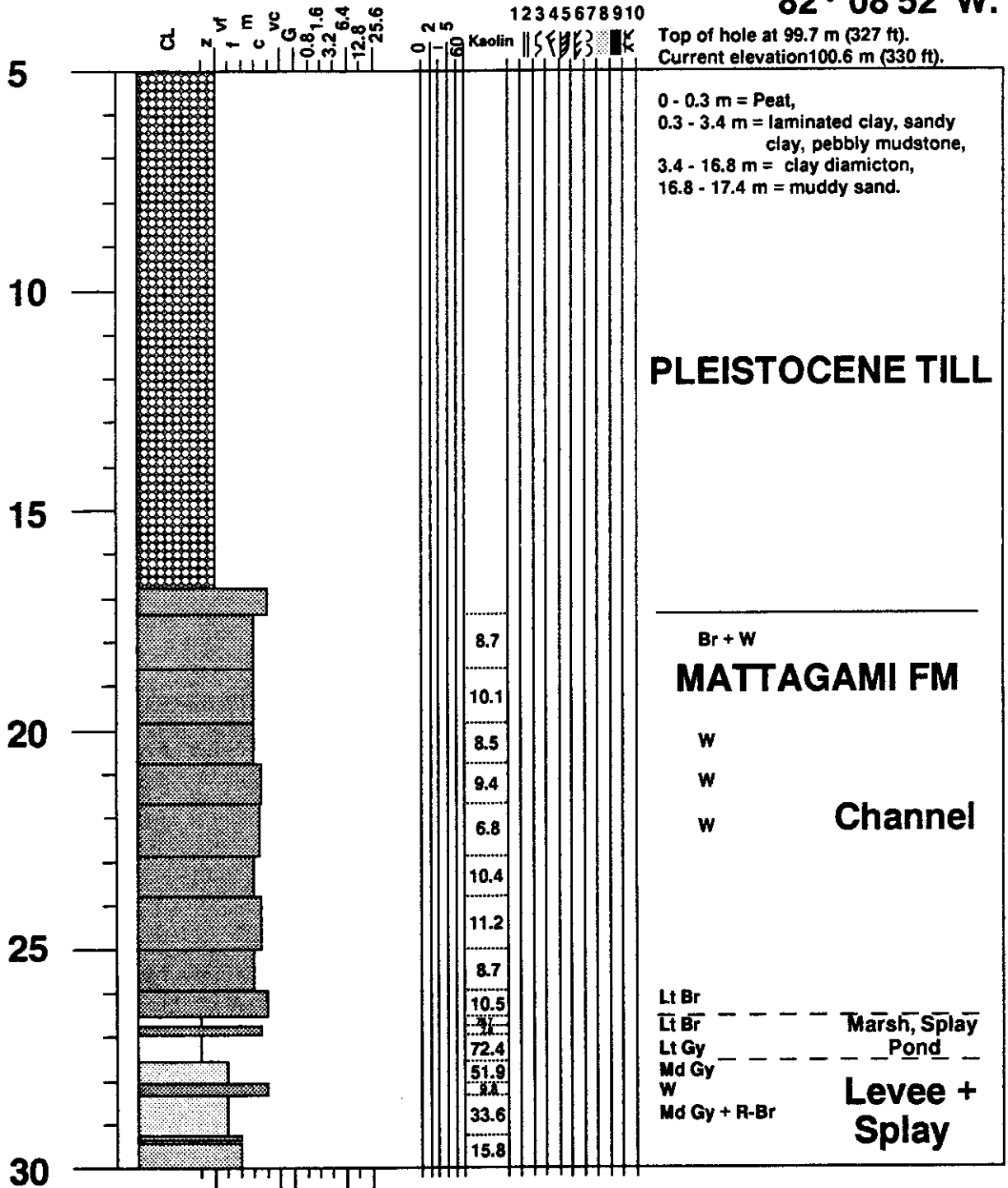
MRC hole 89 - 75, Kipling Twp.

50° 08'51"N,
82° 08'52"W.



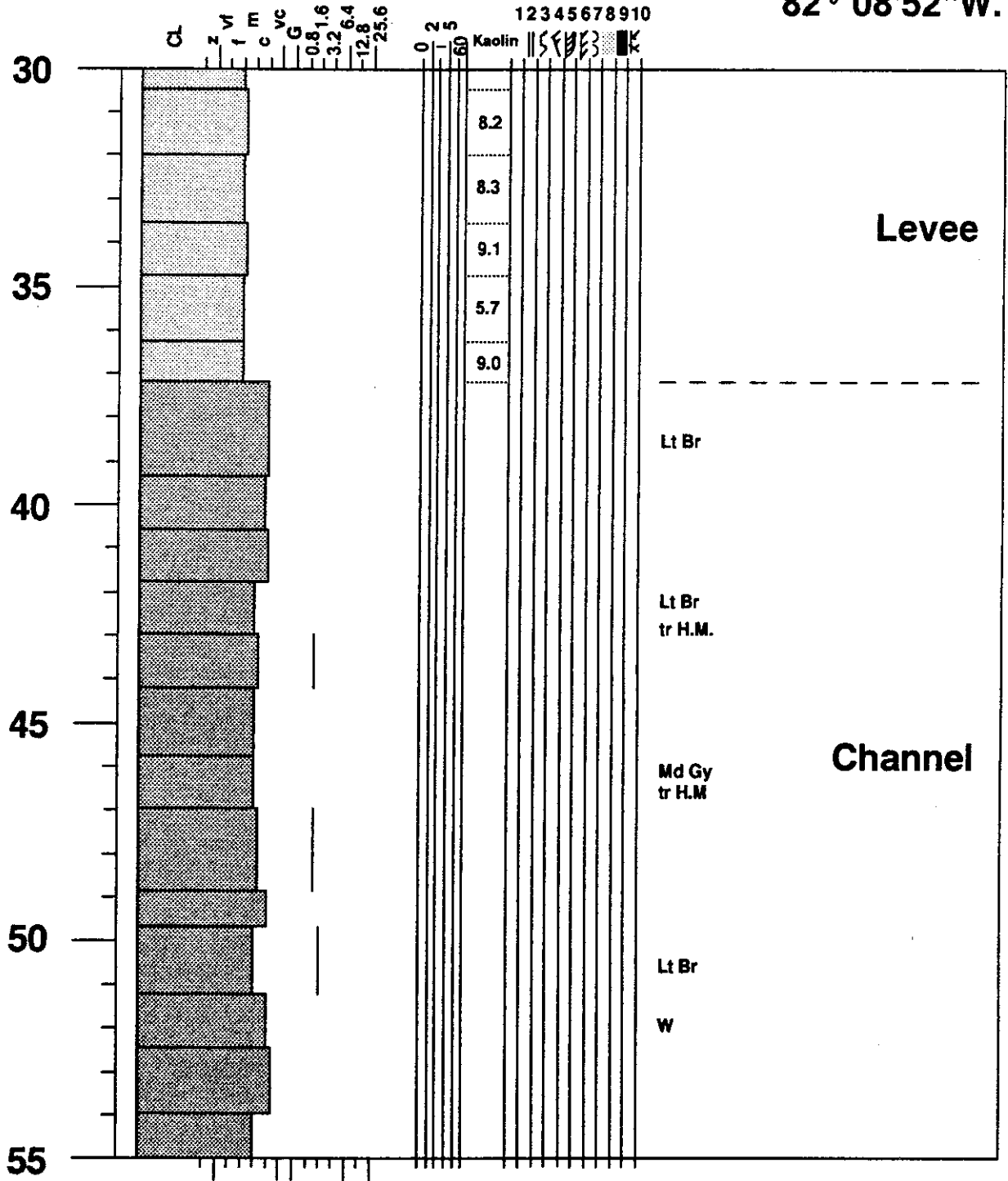
MRC hole 89 - 76, Kipling Twp.

50° 08'48"N,
82° 08'52"W.



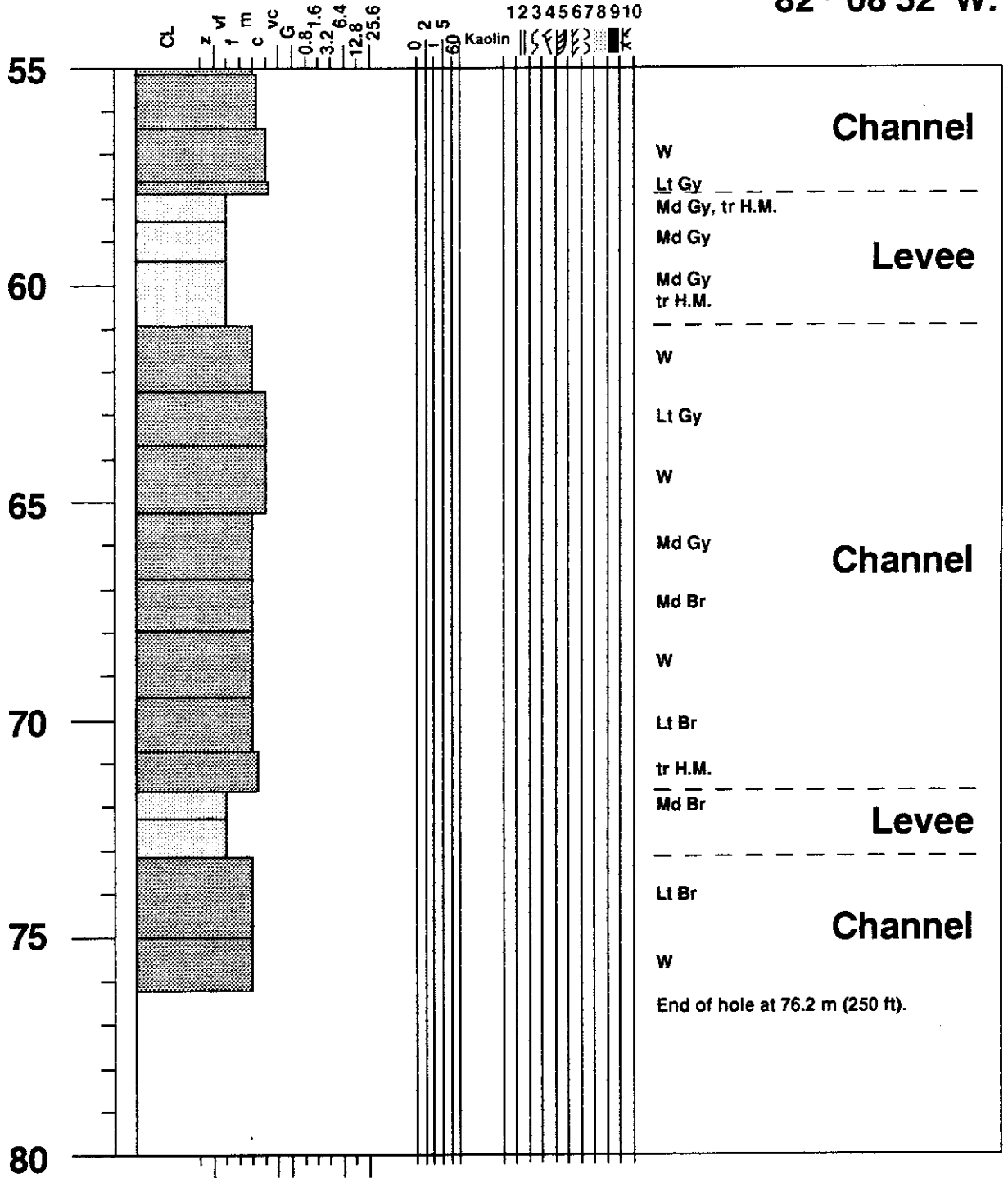
MRC hole 89 - 76, Kipling Twp.

50° 08'48"N,
82° 08'52"W.



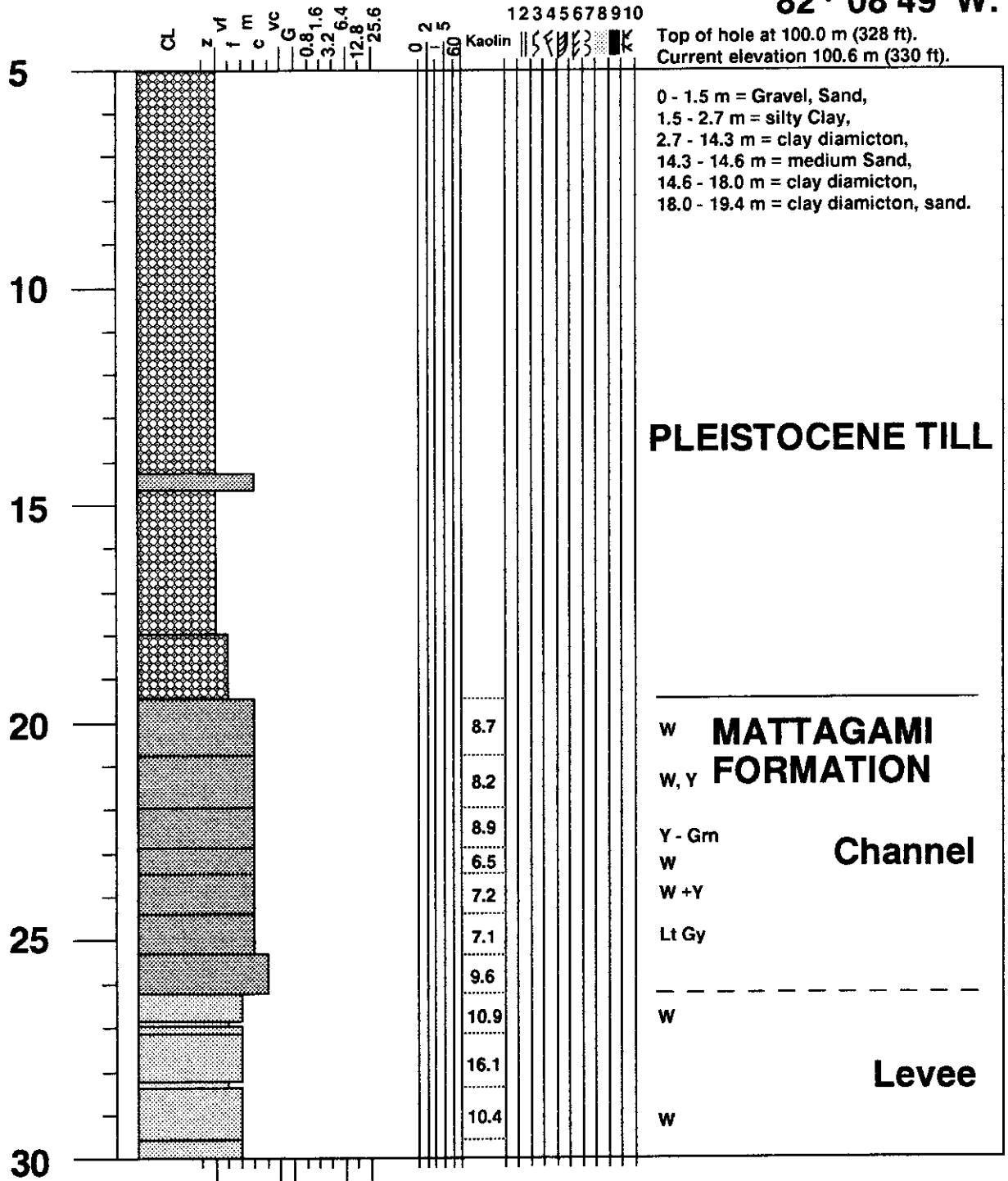
MRC hole 89 - 76, Kipling Twp.

50° 08'48"N,
82° 08'52"W.



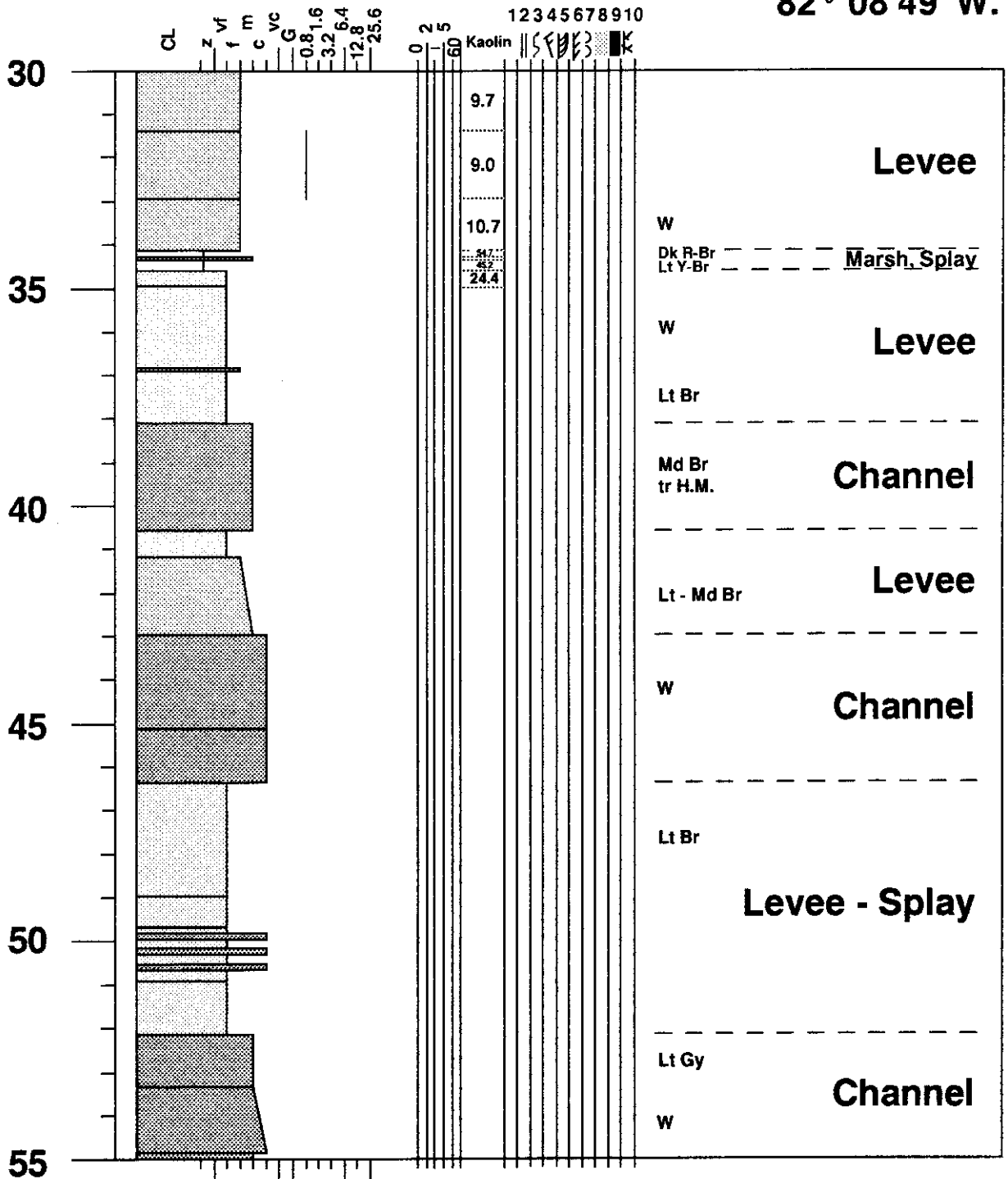
MRC hole 89 - 78, Kipling Twp.

50° 08'45"N,
82° 08'49"W.



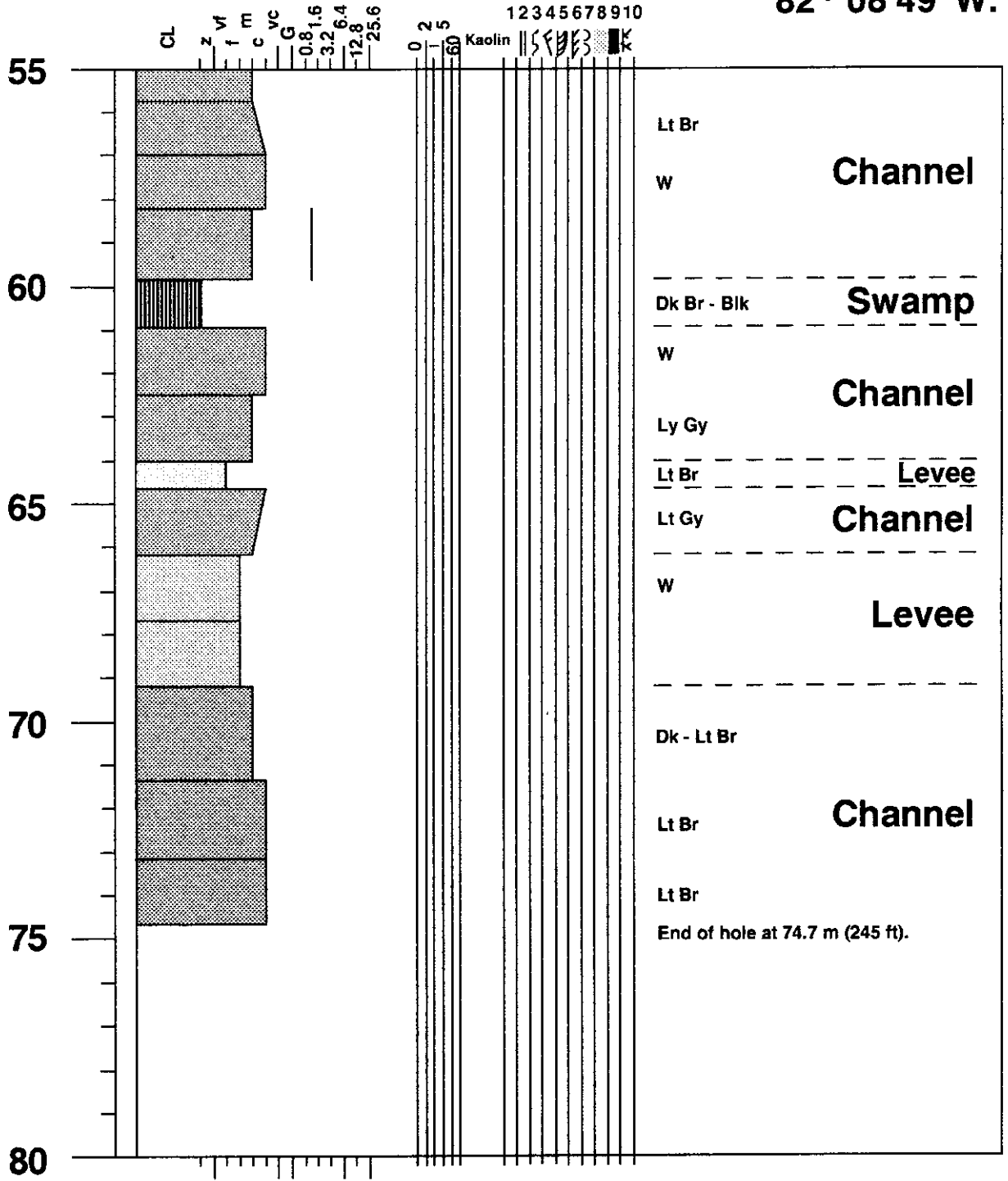
MRC hole 89 - 78, Kipling Twp.

50° 08'45"N,
82° 08'49"W.



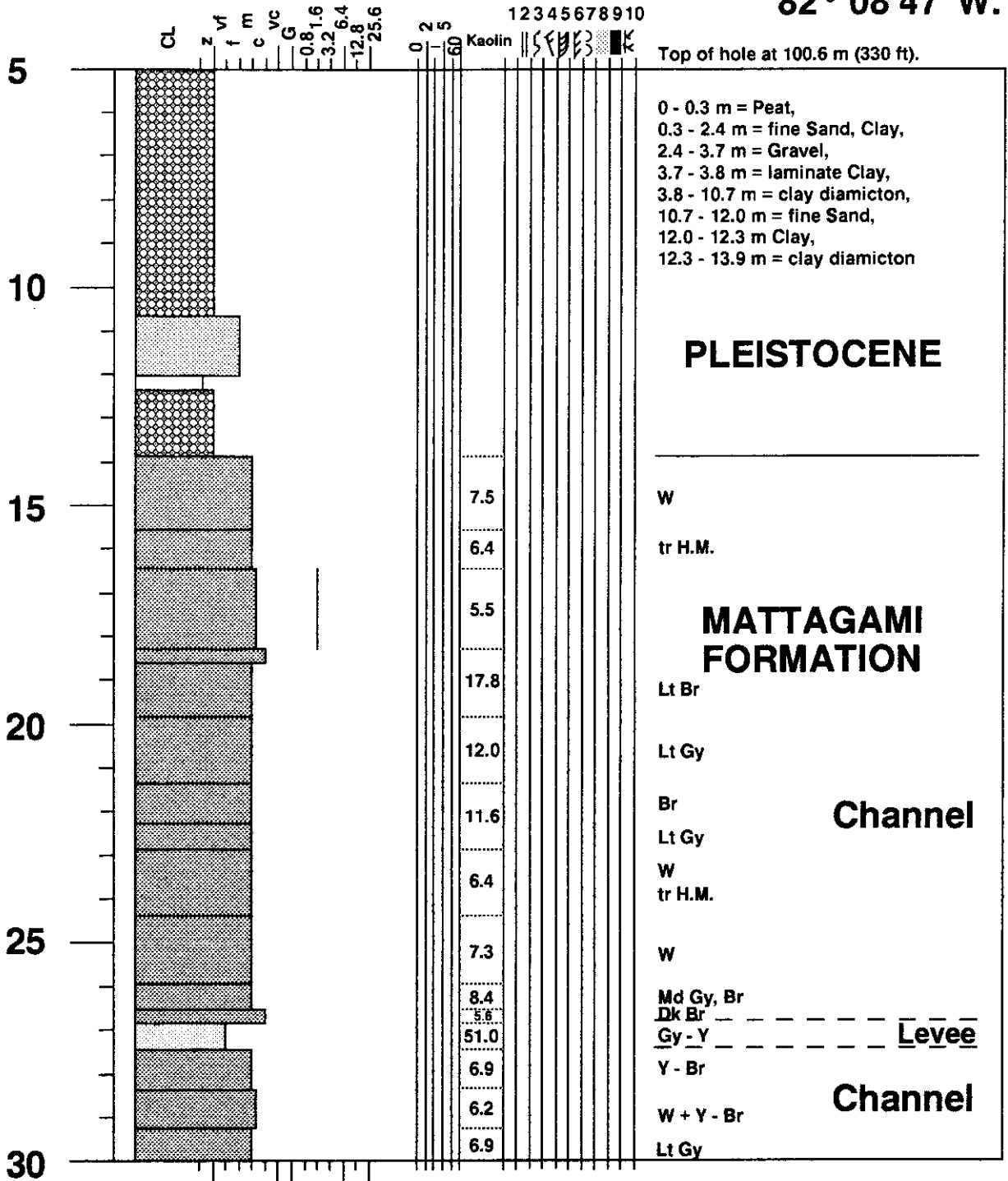
MRC hole 89 - 78, Kipling Twp.

50° 08'45"N,
82° 08'49"W.



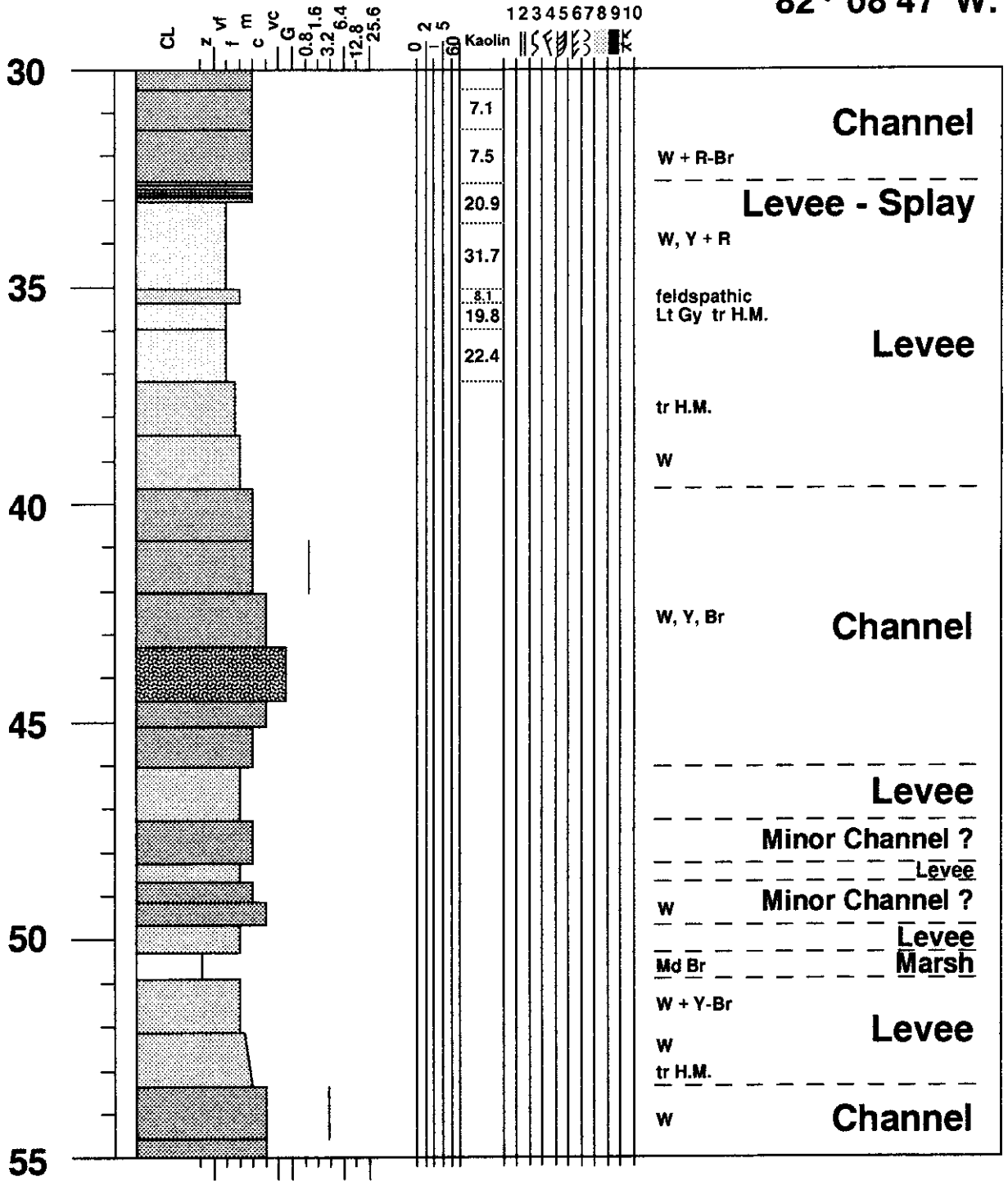
MRC hole 89 - 80, Kipling Twp.

50° 08'50"N,
82° 08'47"W.



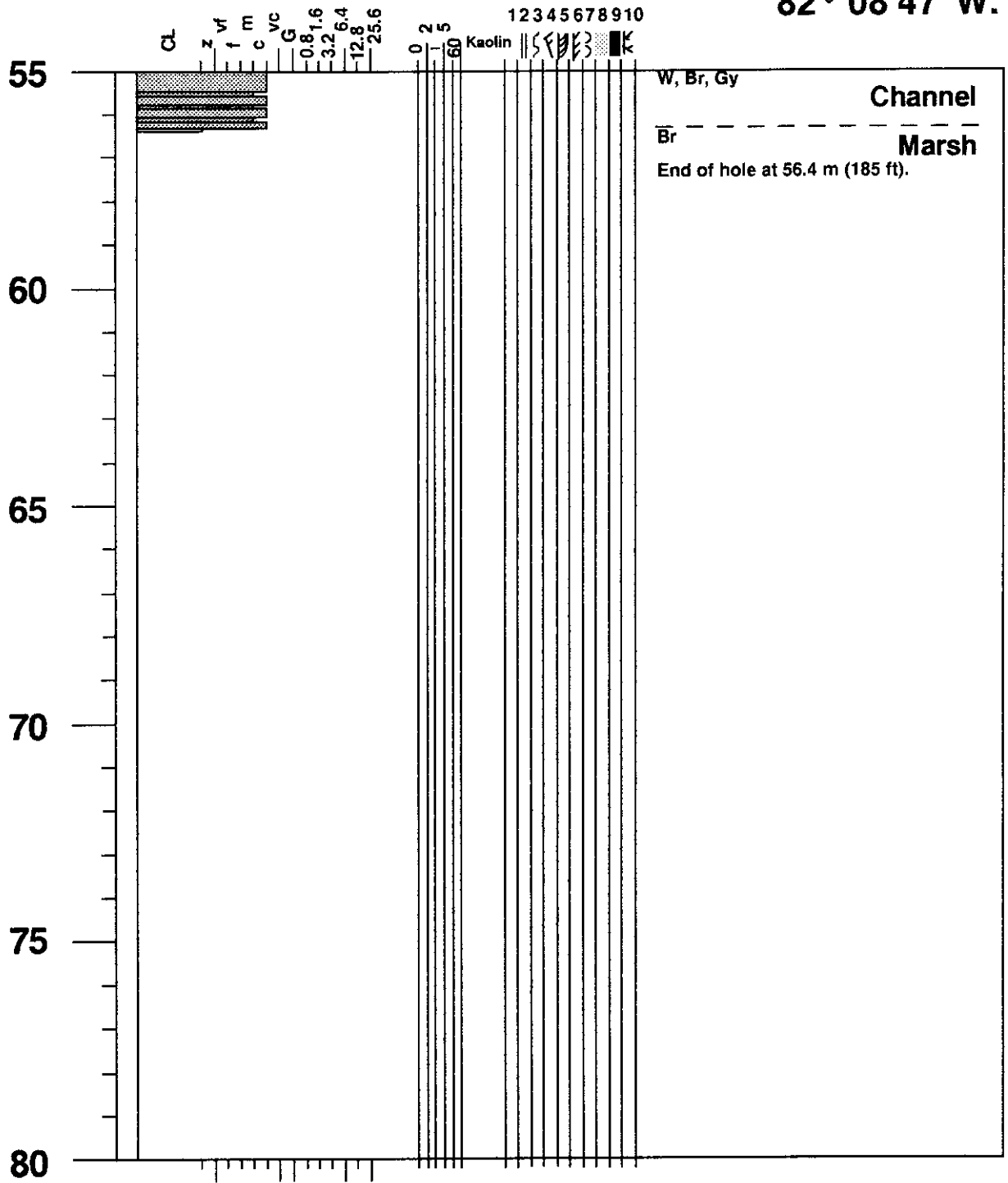
MRC hole 89 - 80, Kipling Twp.

50° 08'50"N,
82° 08'47"W.



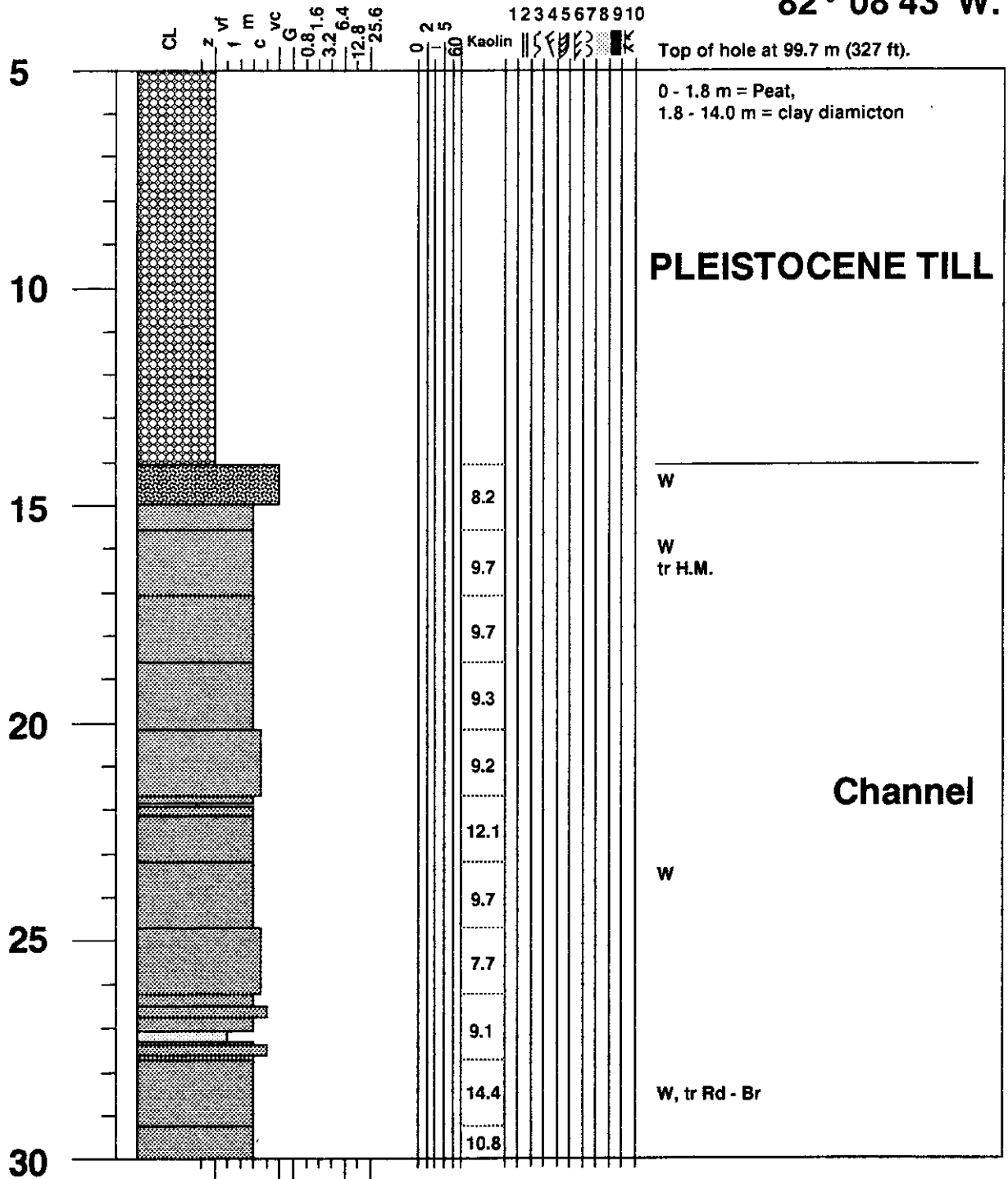
MRC hole 89 - 80, Kipling Twp.

**50° 08'50"N,
82° 08'47"W.**



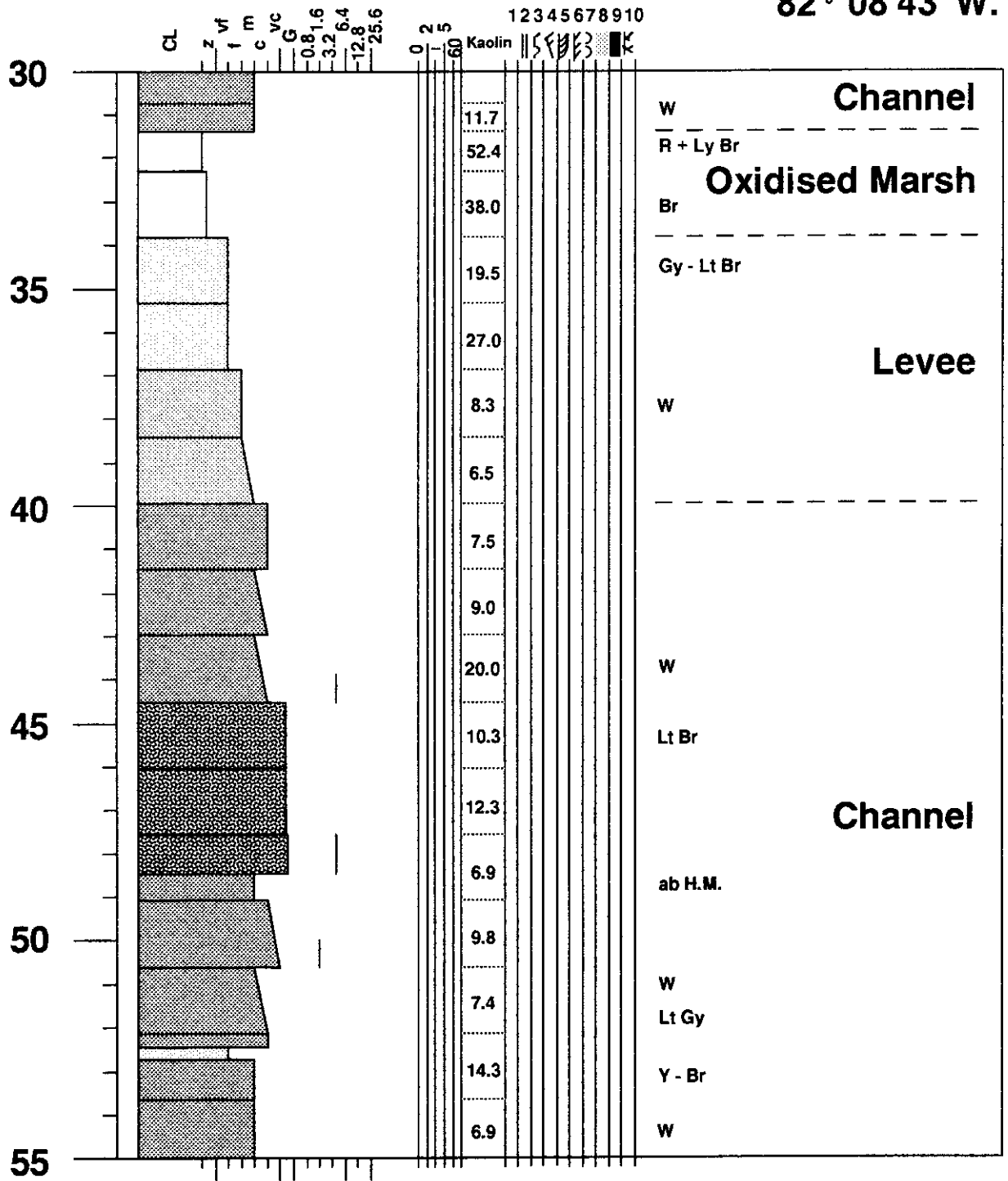
MRC hole 89 - 83, Kipling Twp.

50° 08'48"N,
82° 08'43"W.



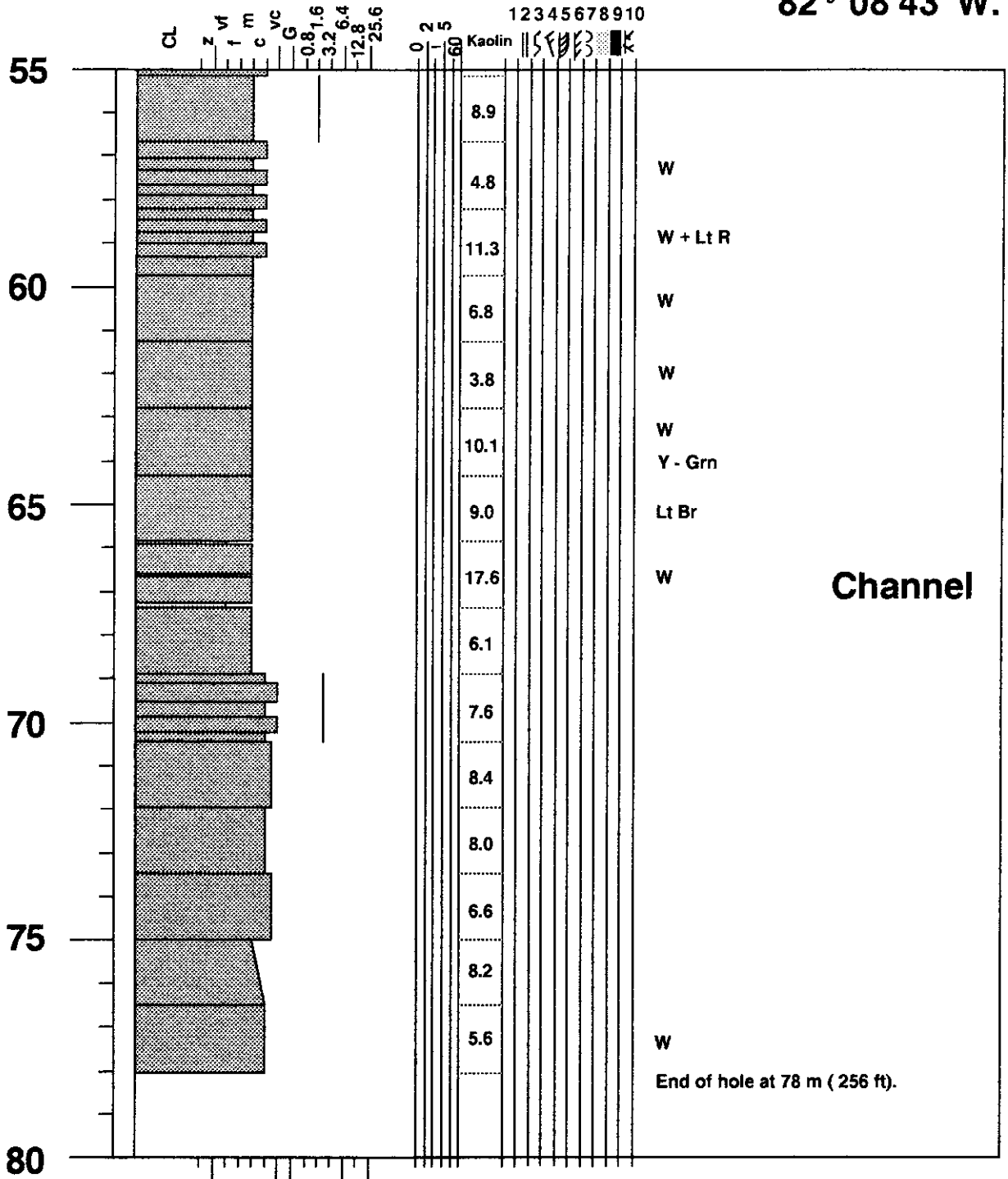
MRC hole 89 - 83, Kipling Twp.

50° 08'48"N,
82° 08'43"W.



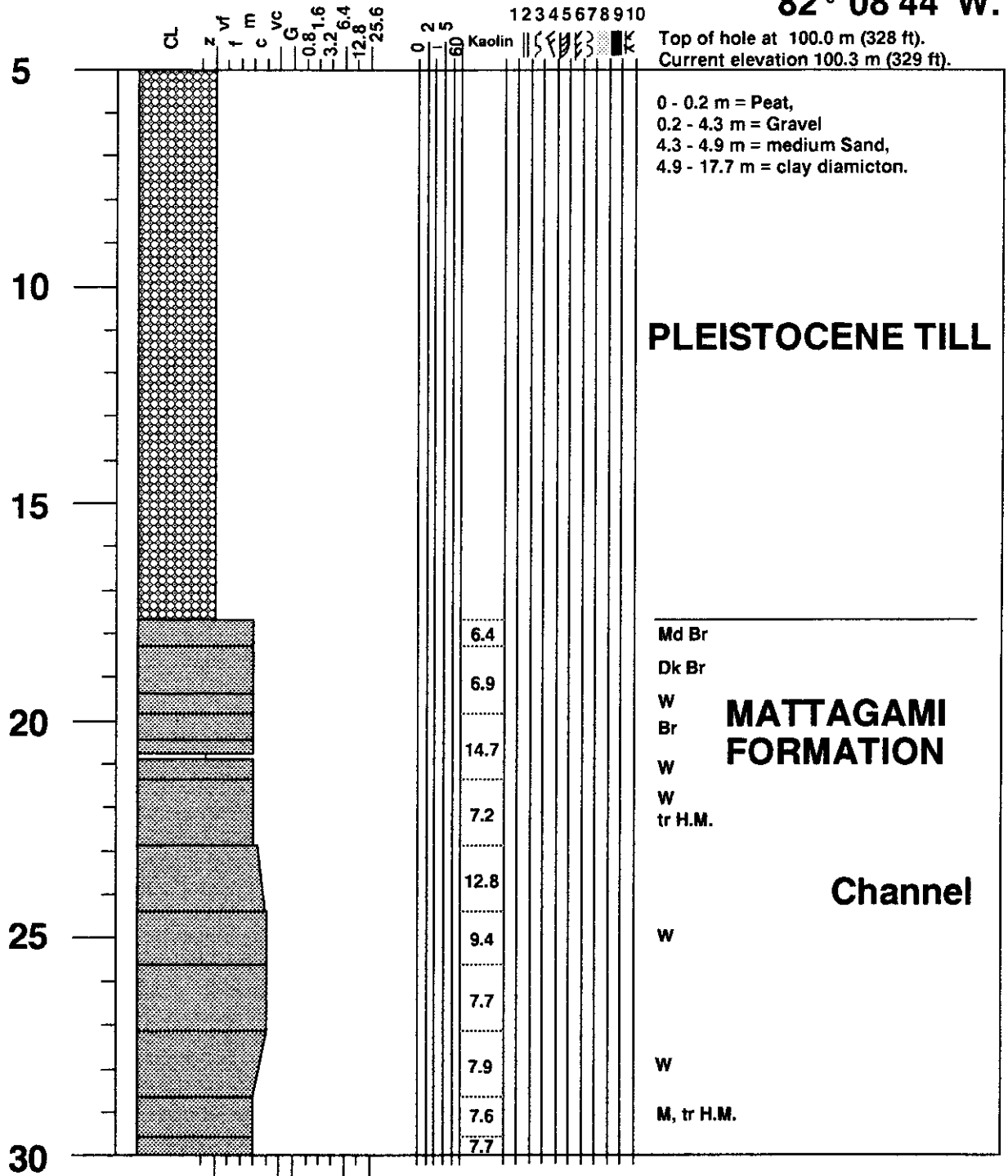
MRC hole 89 - 83, Kipling Twp.

50° 08'48"N,
82° 08'43"W.



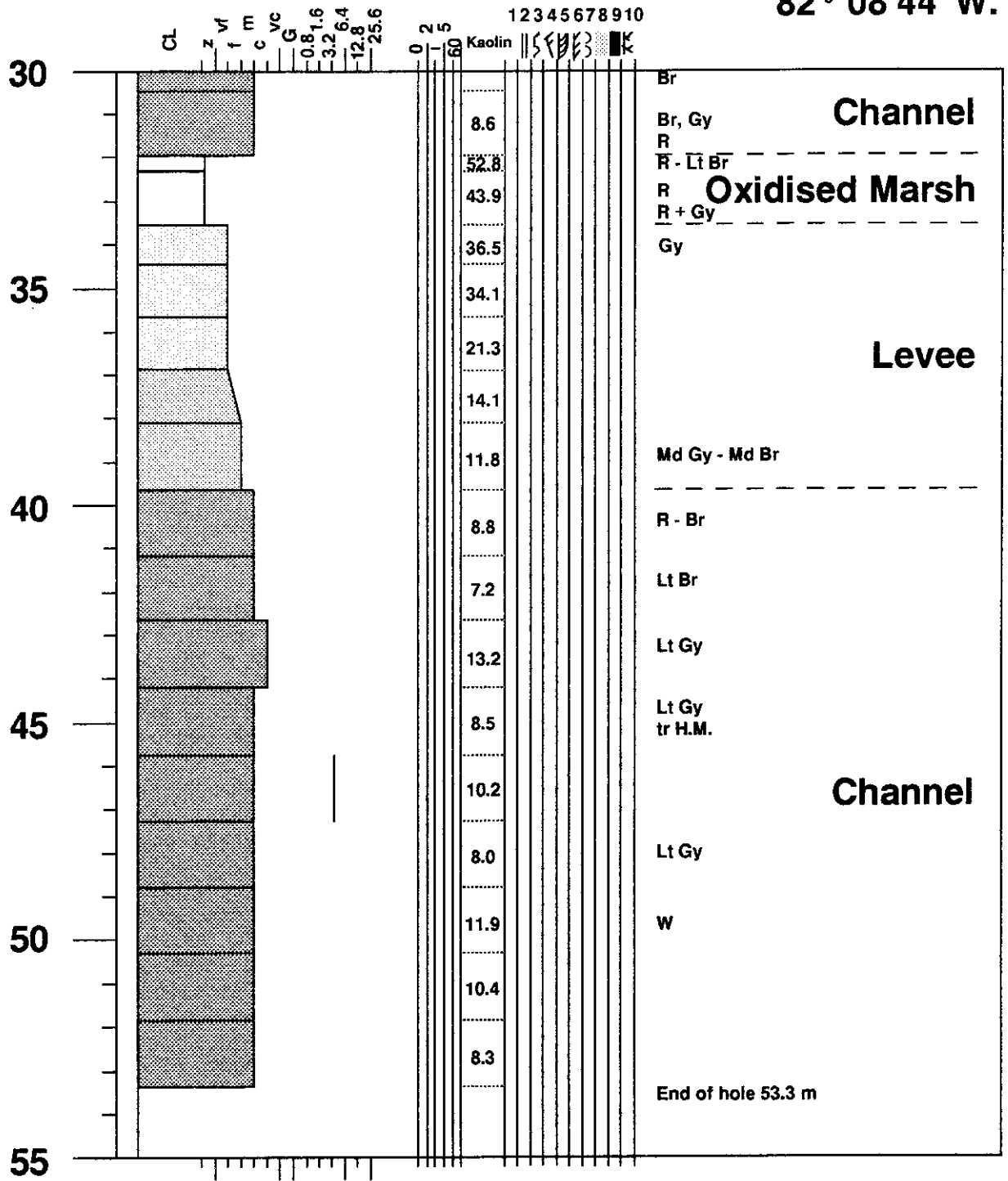
MRC hole 89 - 84, Kipling Twp.

50° 08'45"N,
82° 08'44"W.



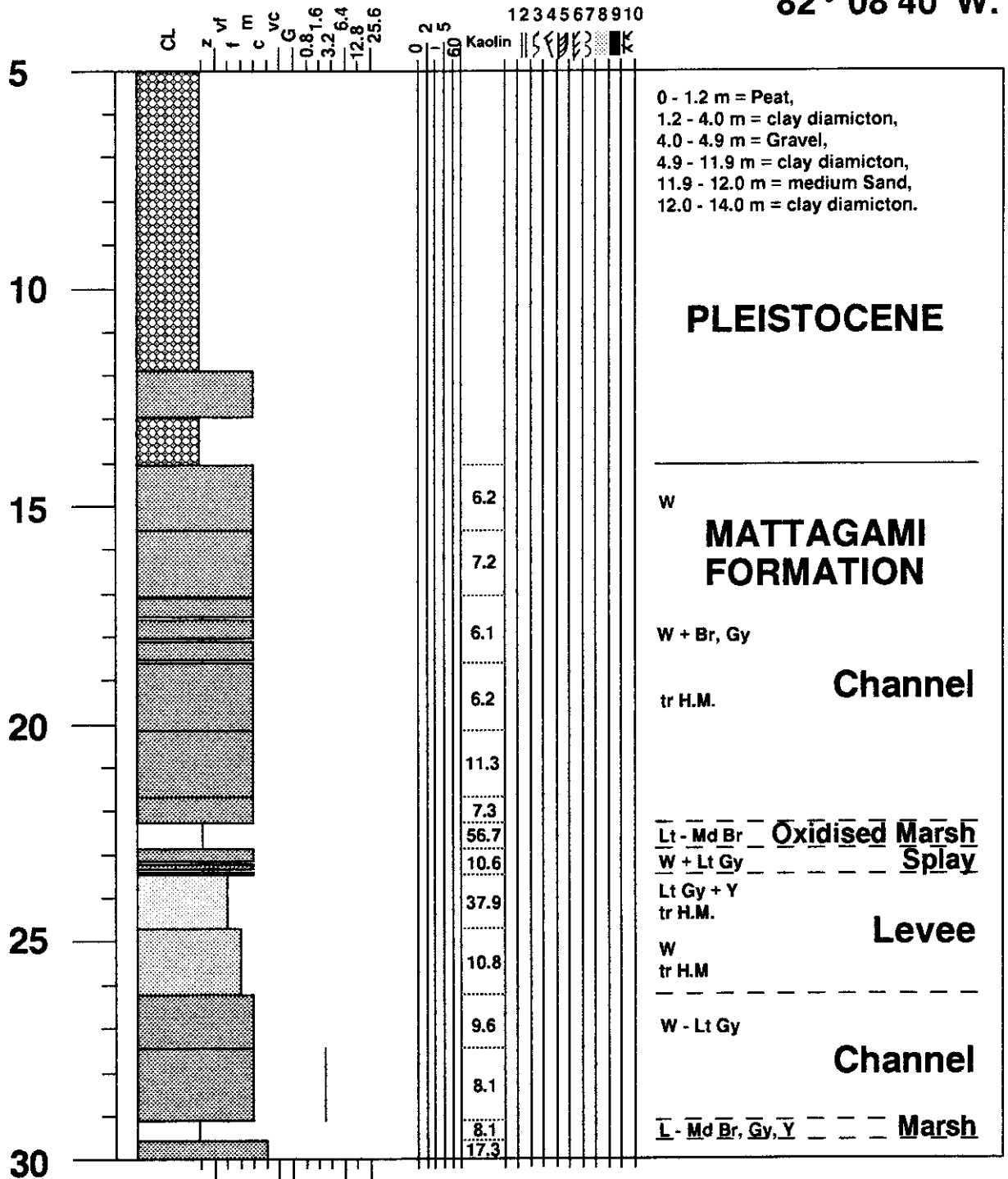
MRC hole 89 - 84, Kipling Twp.

50° 08'45"N,
82° 08'44"W.



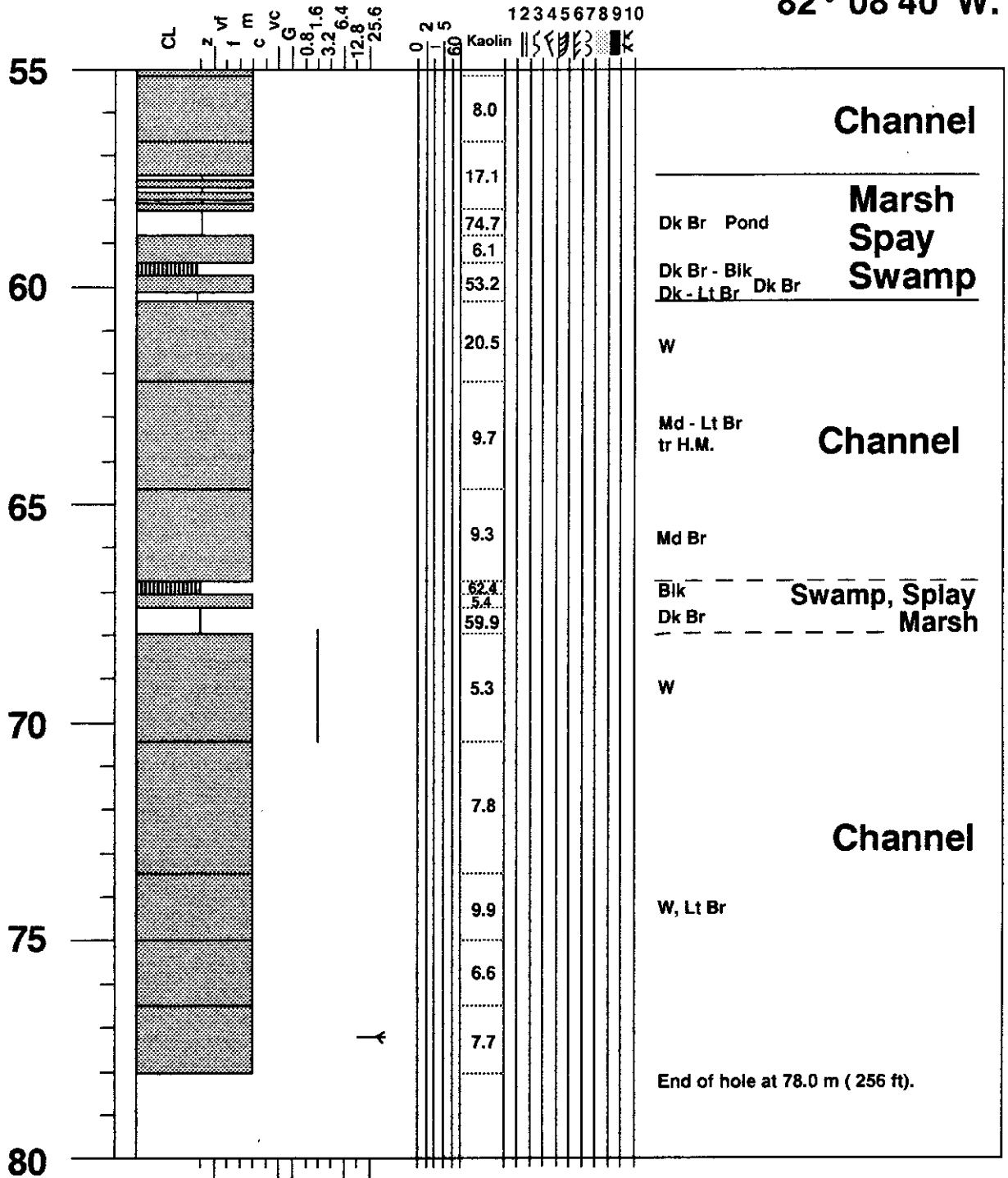
MRC hole 89 - 86, Kipling Twp.

50° 08'47"N,
82° 08'40"W.



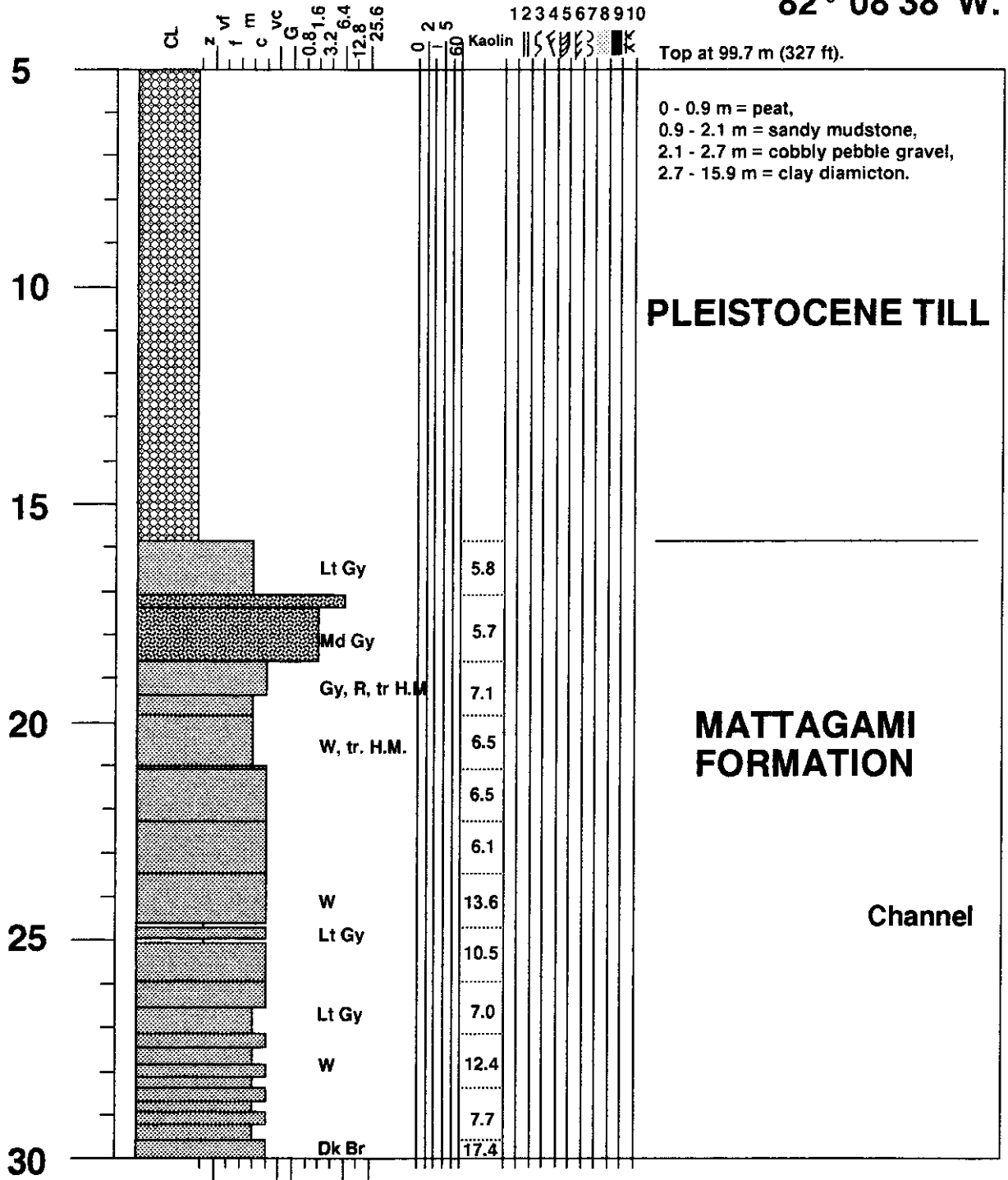
MRC hole 89 - 86, Kipling Twp.

50° 08'47"N,
82° 08'40"W.



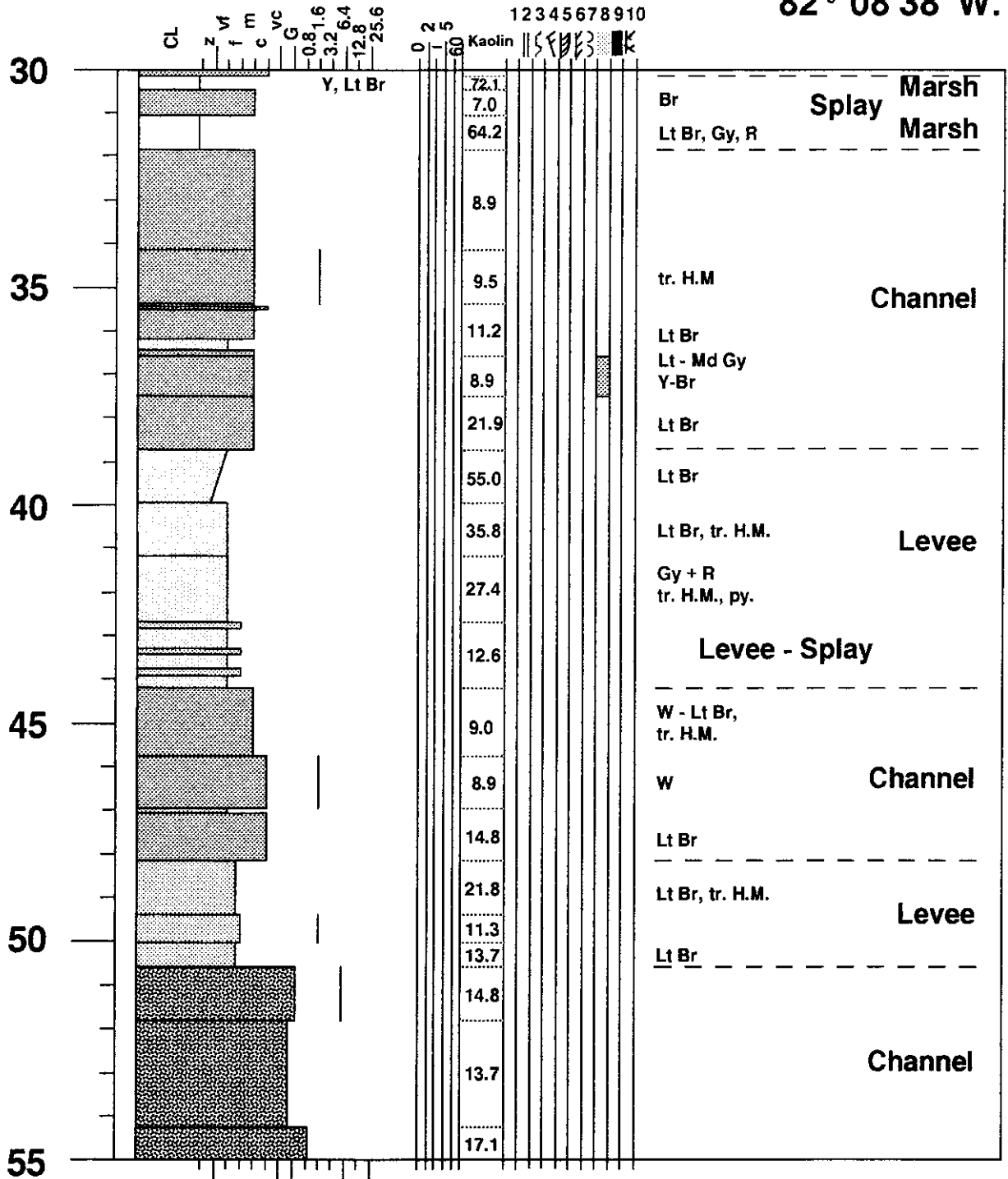
MRC hole 89 - 87, Kipling Twp.

50° 08'52"N,
82° 08'38"W.



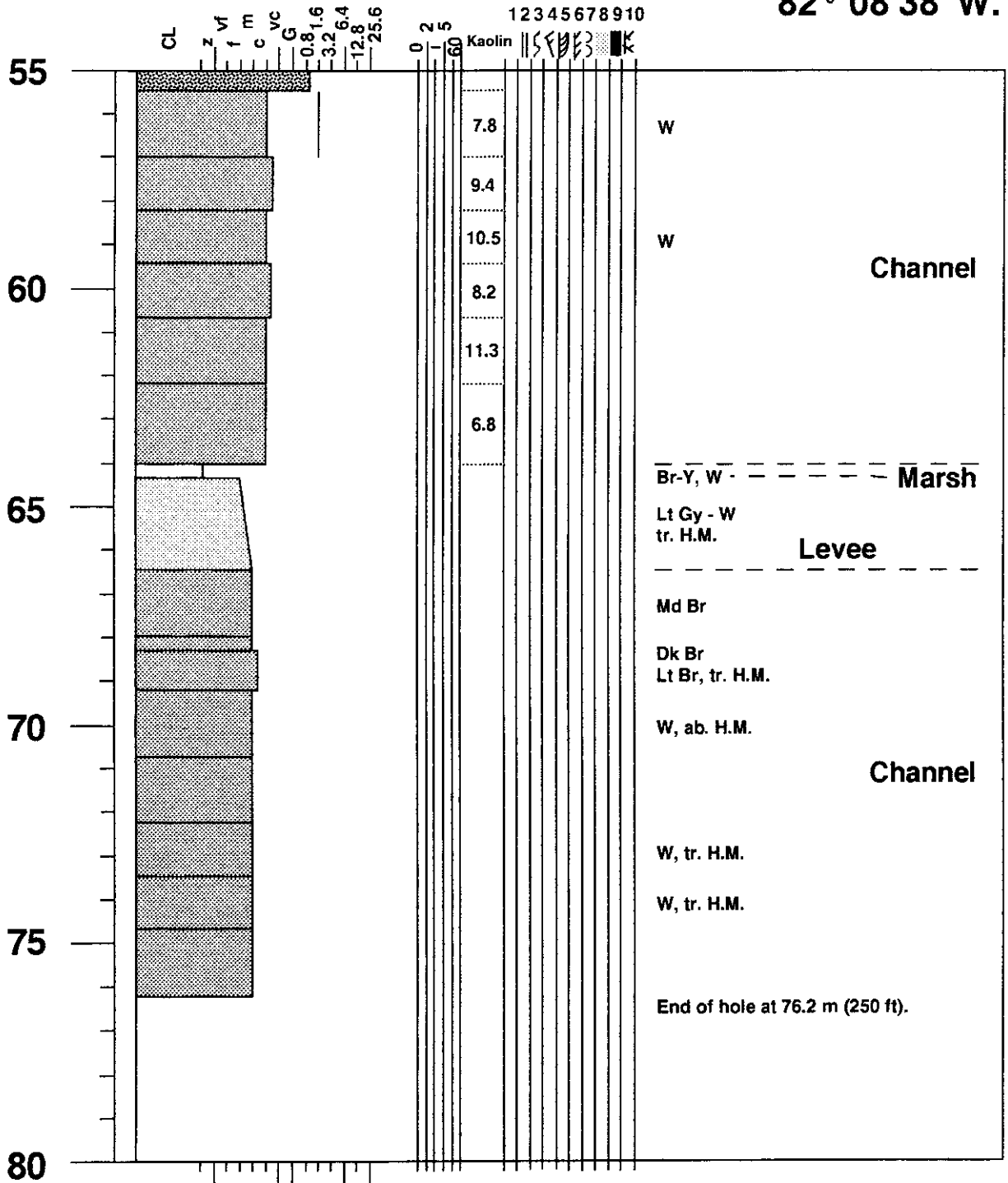
MRC hole 89 - 87, Kipling Twp.

50° 08'52"N,
82° 08'38"W.



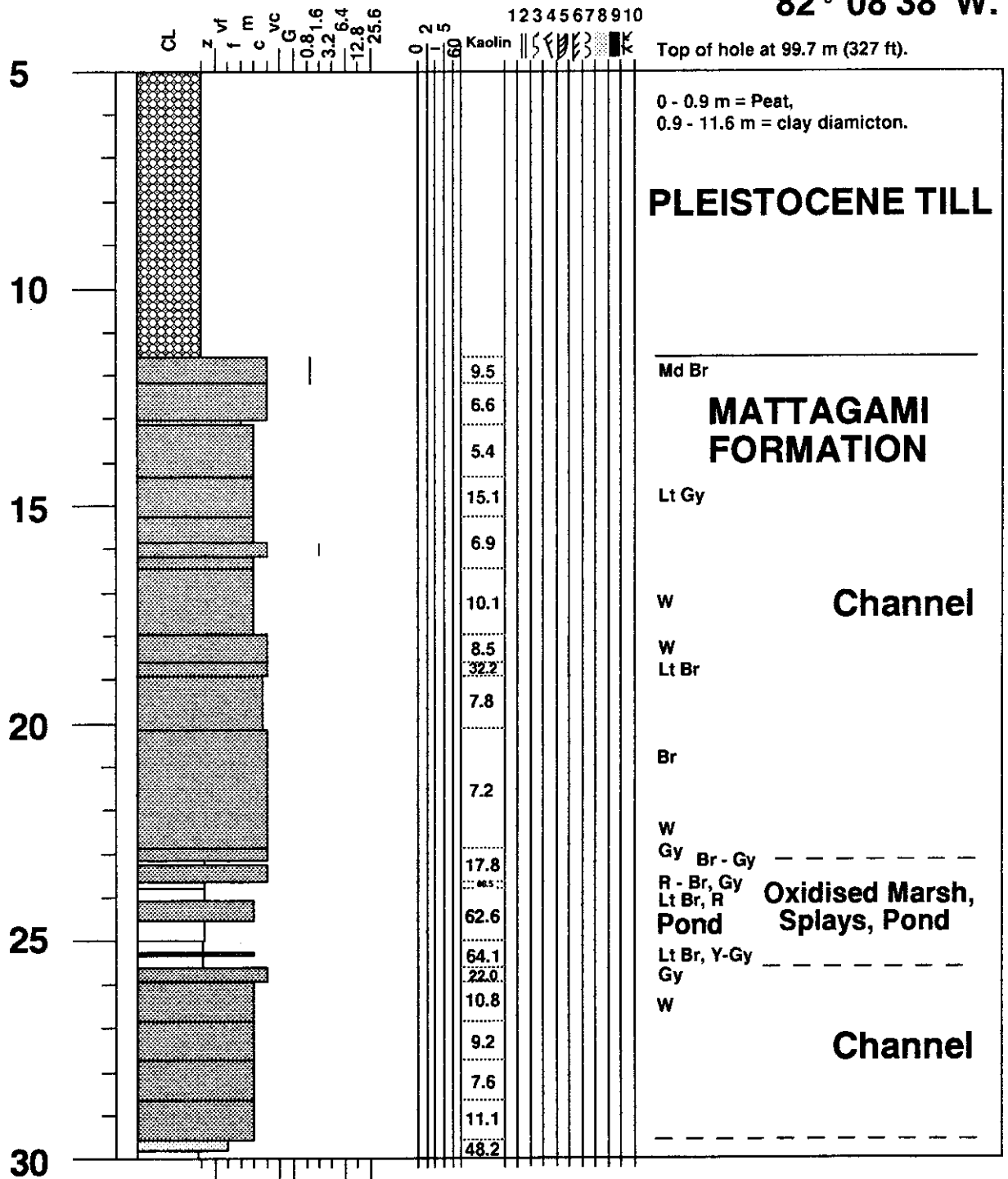
MRC hole 89 - 87, Kipling Twp.

50° 08'52"N,
82° 08'38"W.



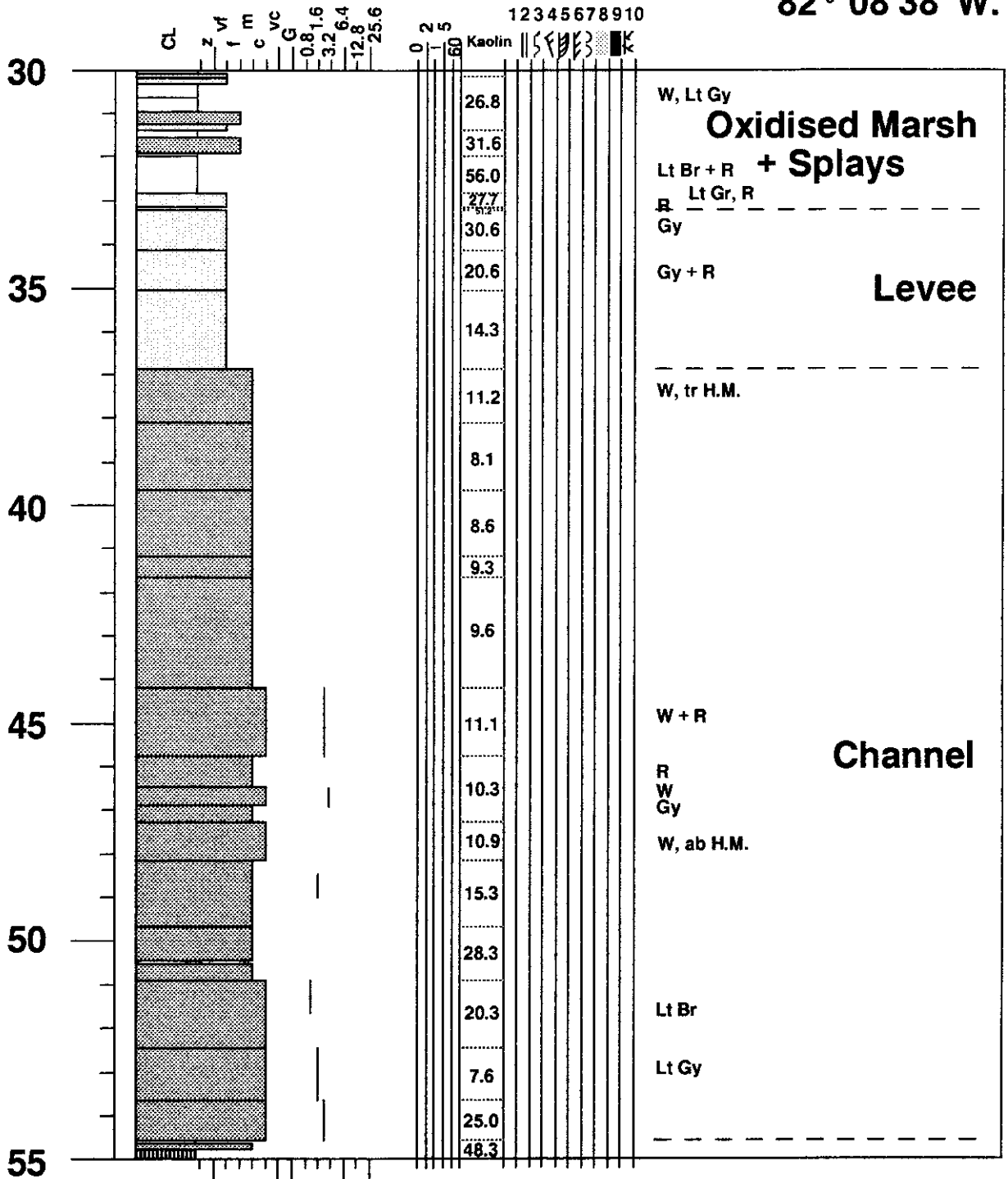
MRC hole 89 - 88, Kipling Twp.

50° 08'48"N,
82° 08'38"W.



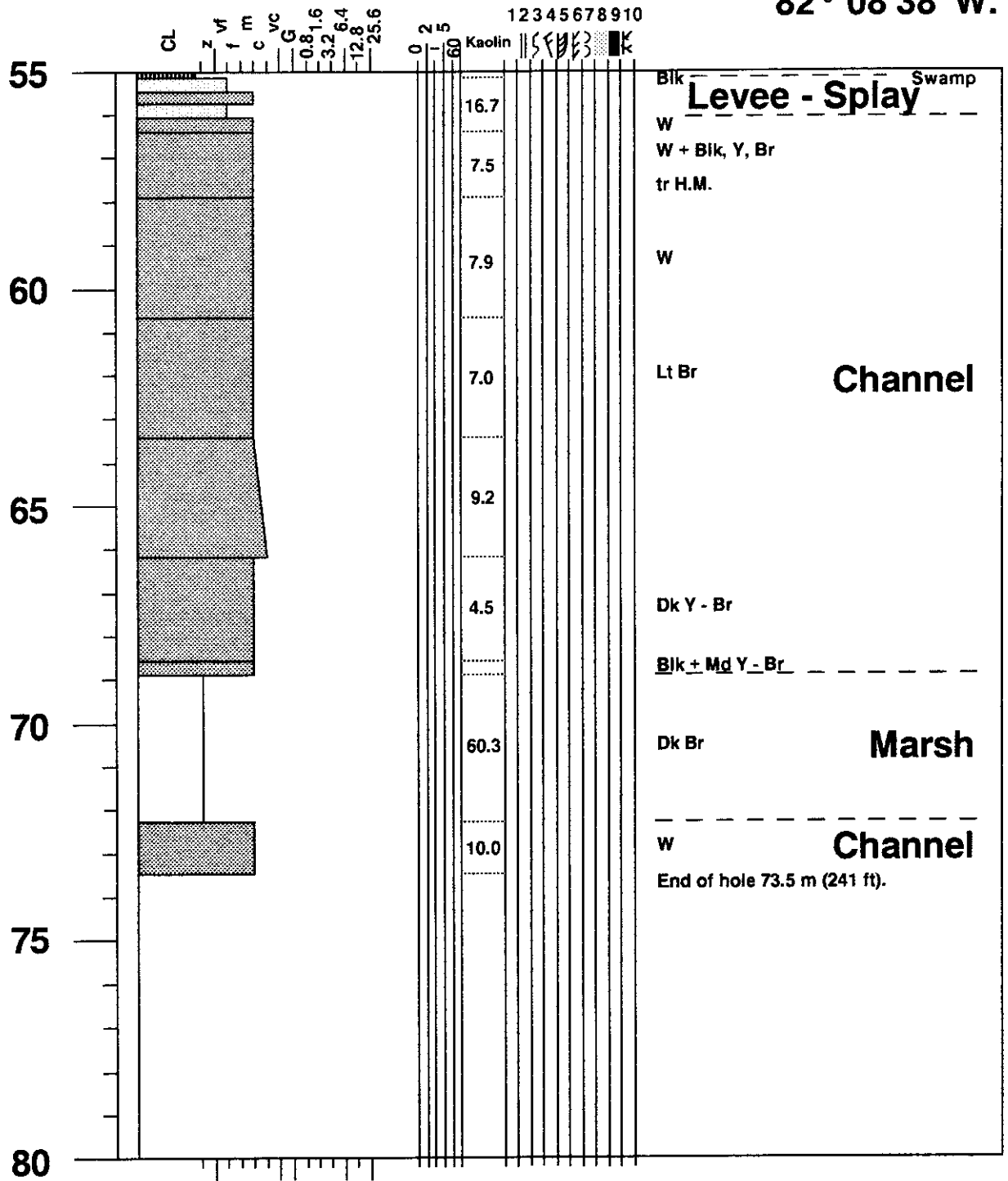
MRC hole 89 - 88, Kipling Twp.

50° 08'48"N,
82° 08'38"W.



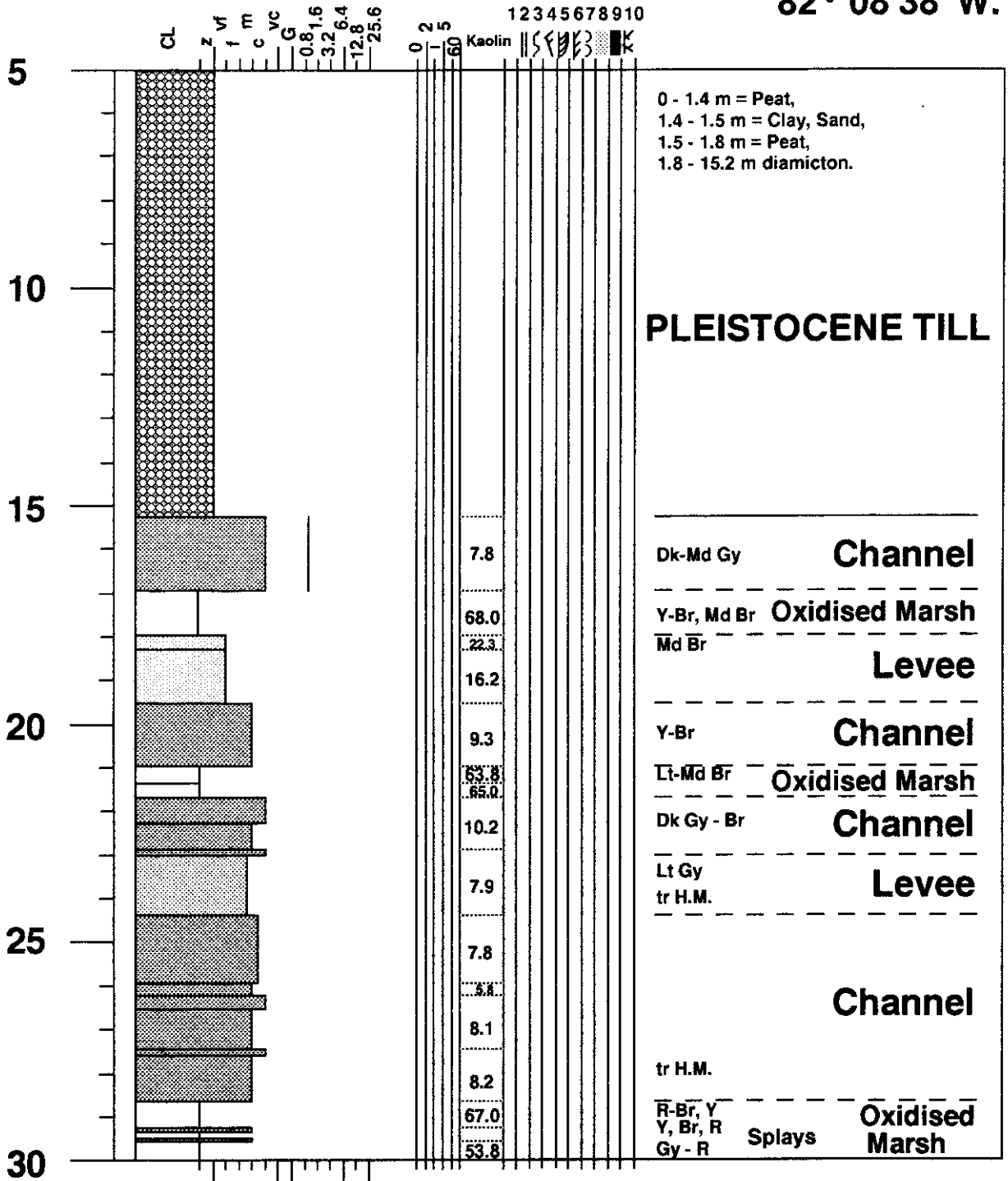
MRC hole 89 - 88, Kipling Twp.

50° 08'48"N,
82° 08'38"W.



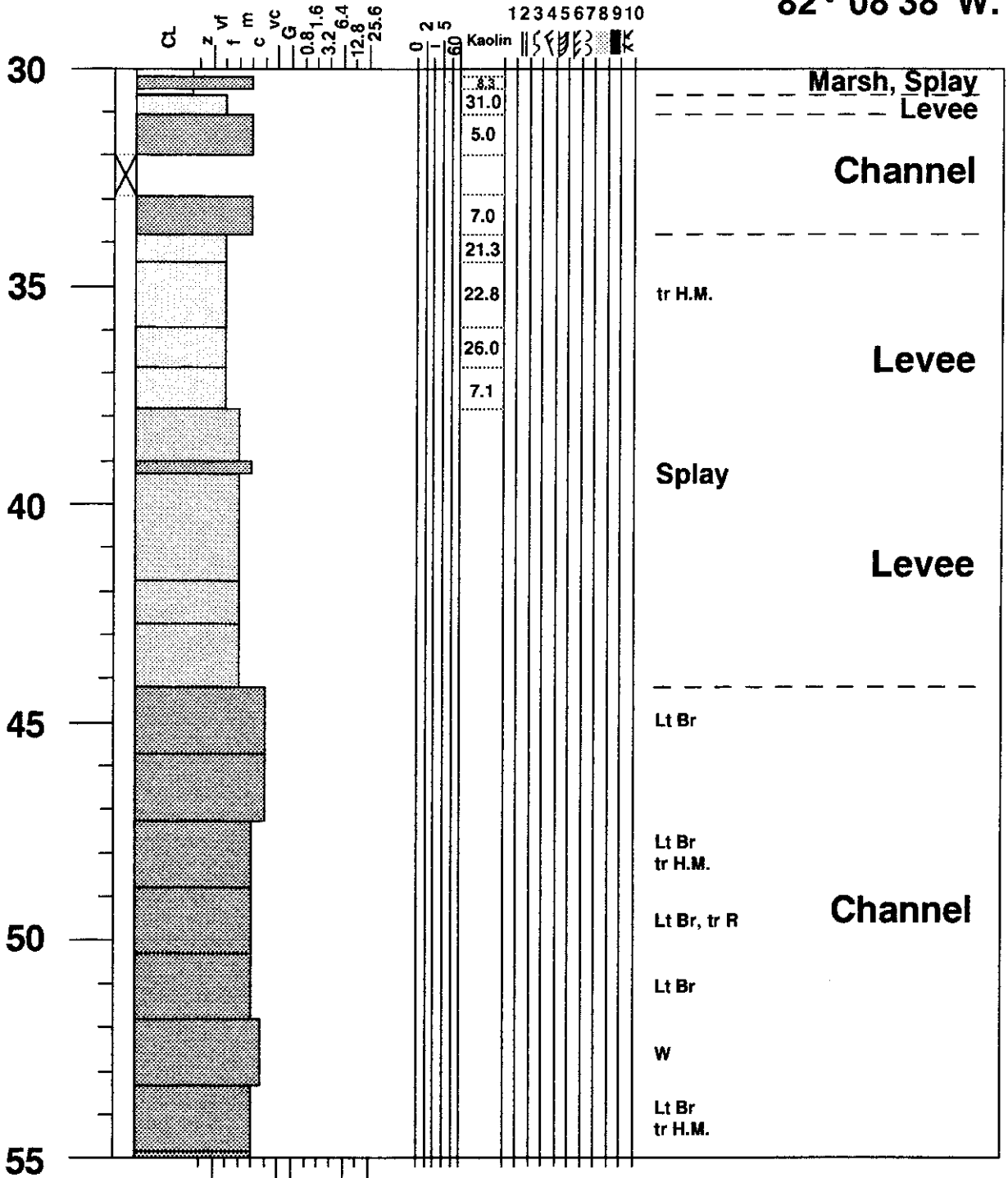
MRC hole 89 - 89, Kipling Twp.

50° 08'45"N,
82° 08'38"W.



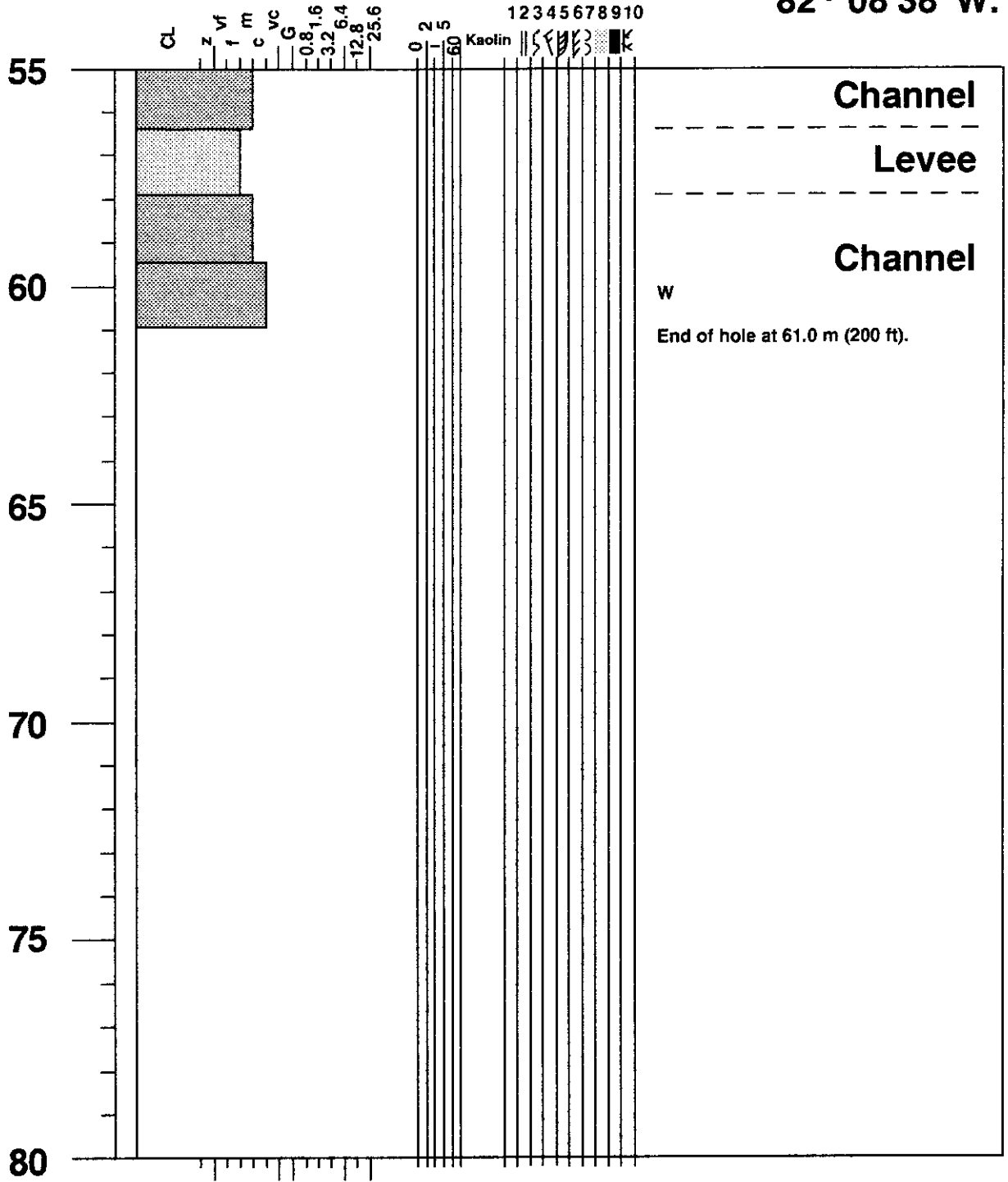
MRC hole 89 - 89, Kipling Twp.

50° 08'45"N,
82° 08'38"W.



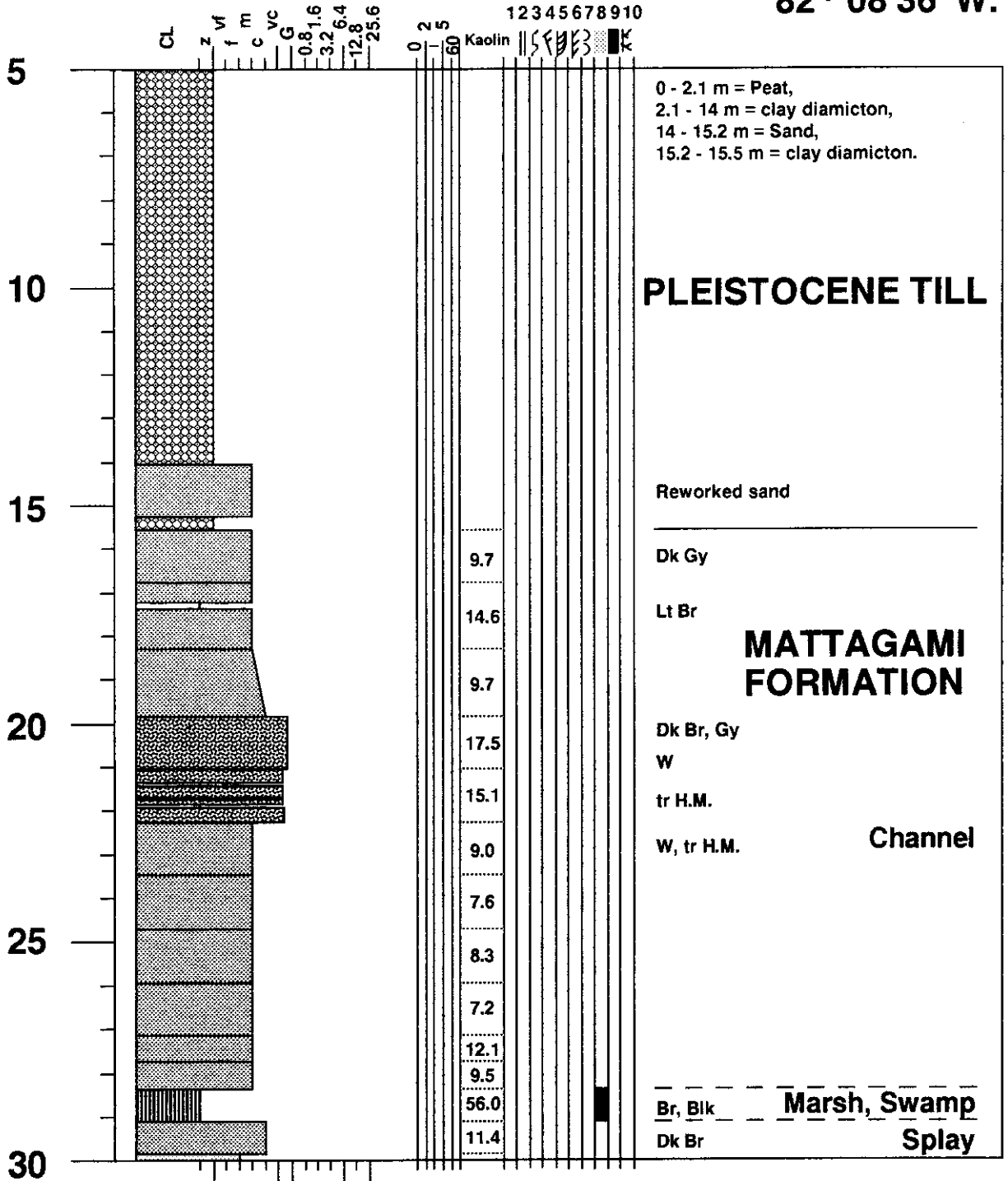
MRC hole 89 - 89, Kipling Twp.

50° 08'45"N,
82° 08'38"W.



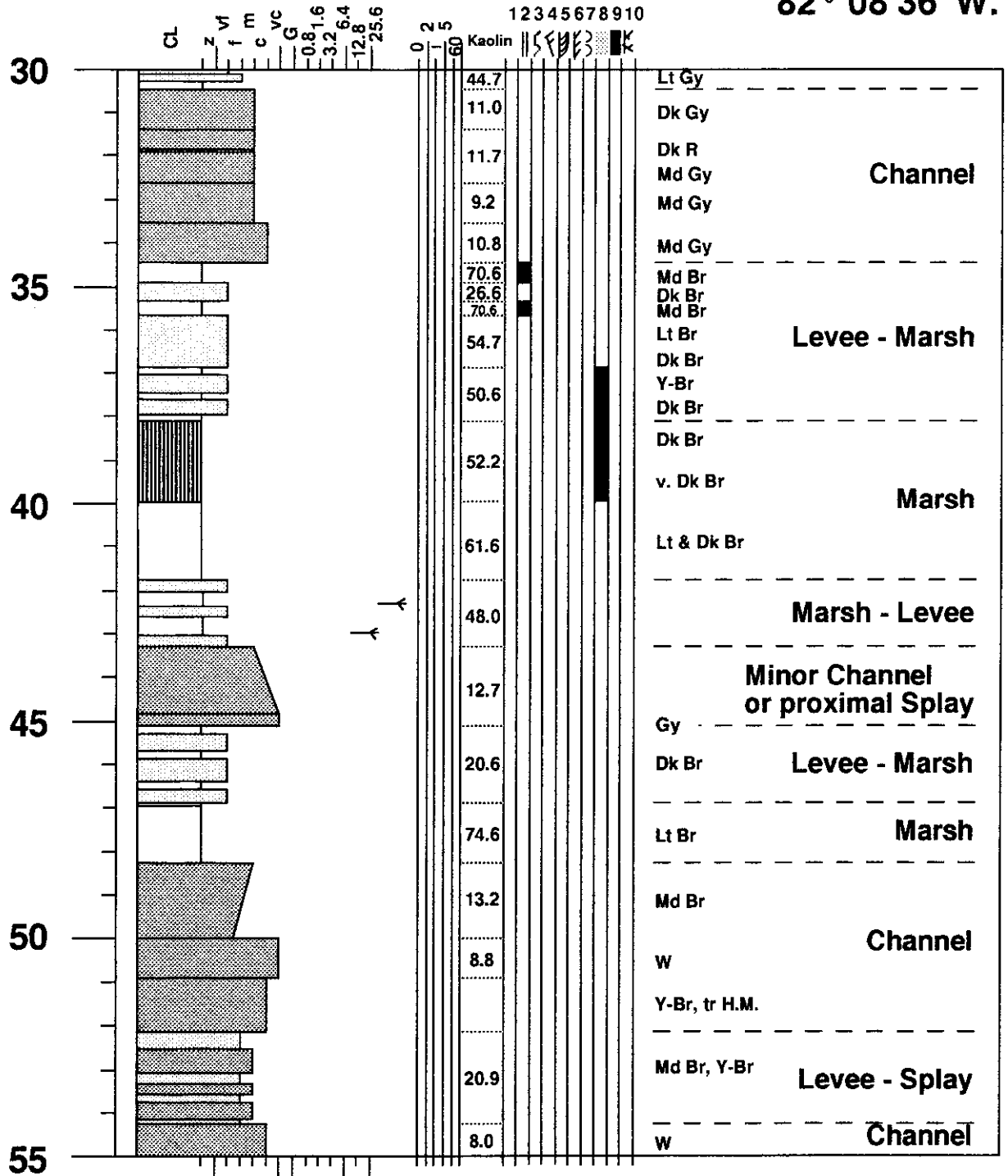
MRC hole 89 - 91, Kipling Twp.

50° 08'50"N,
82° 08'36"W.



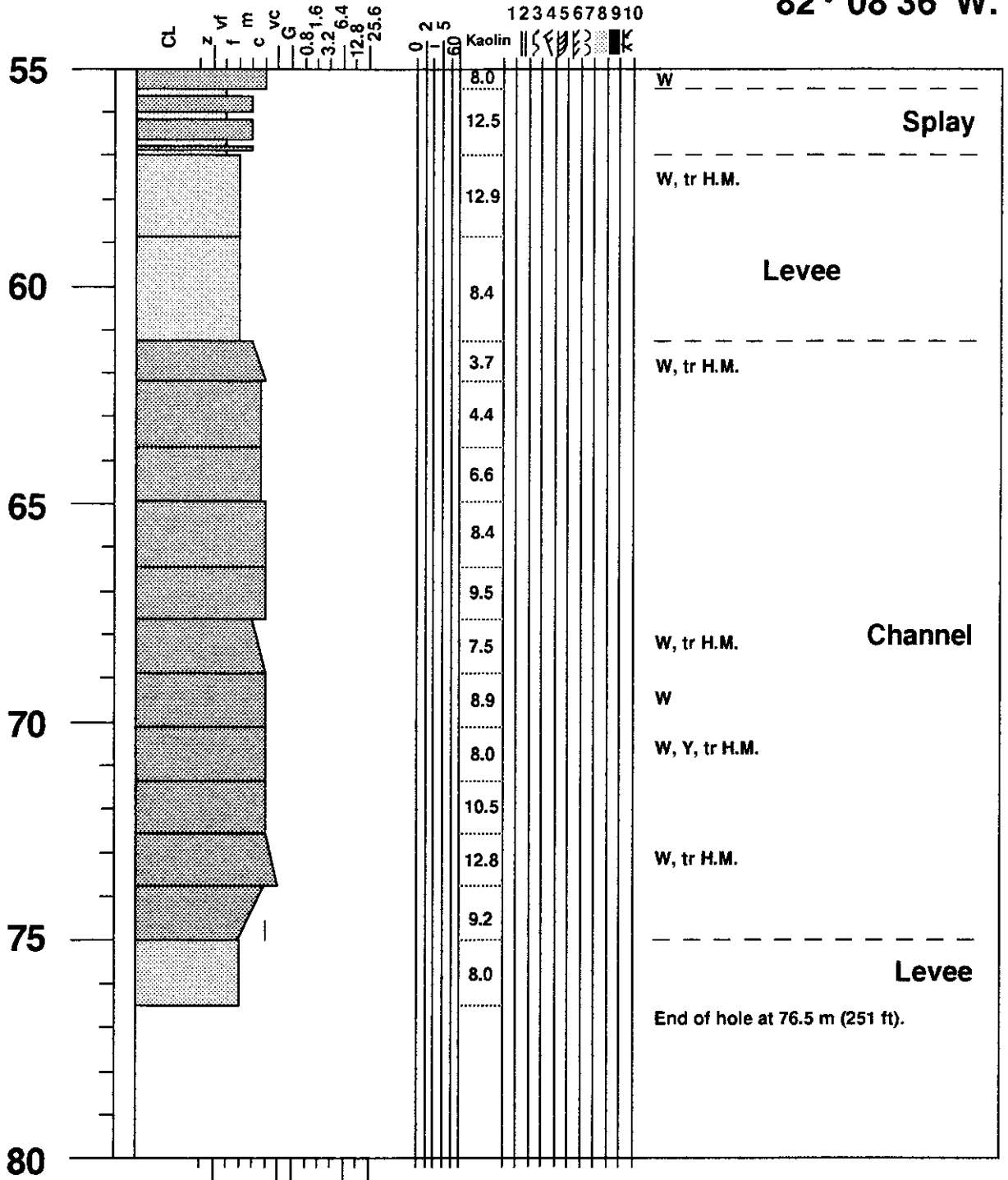
MRC hole 89 - 91, Kipling Twp.

50° 08'50"N,
82° 08'36"W.



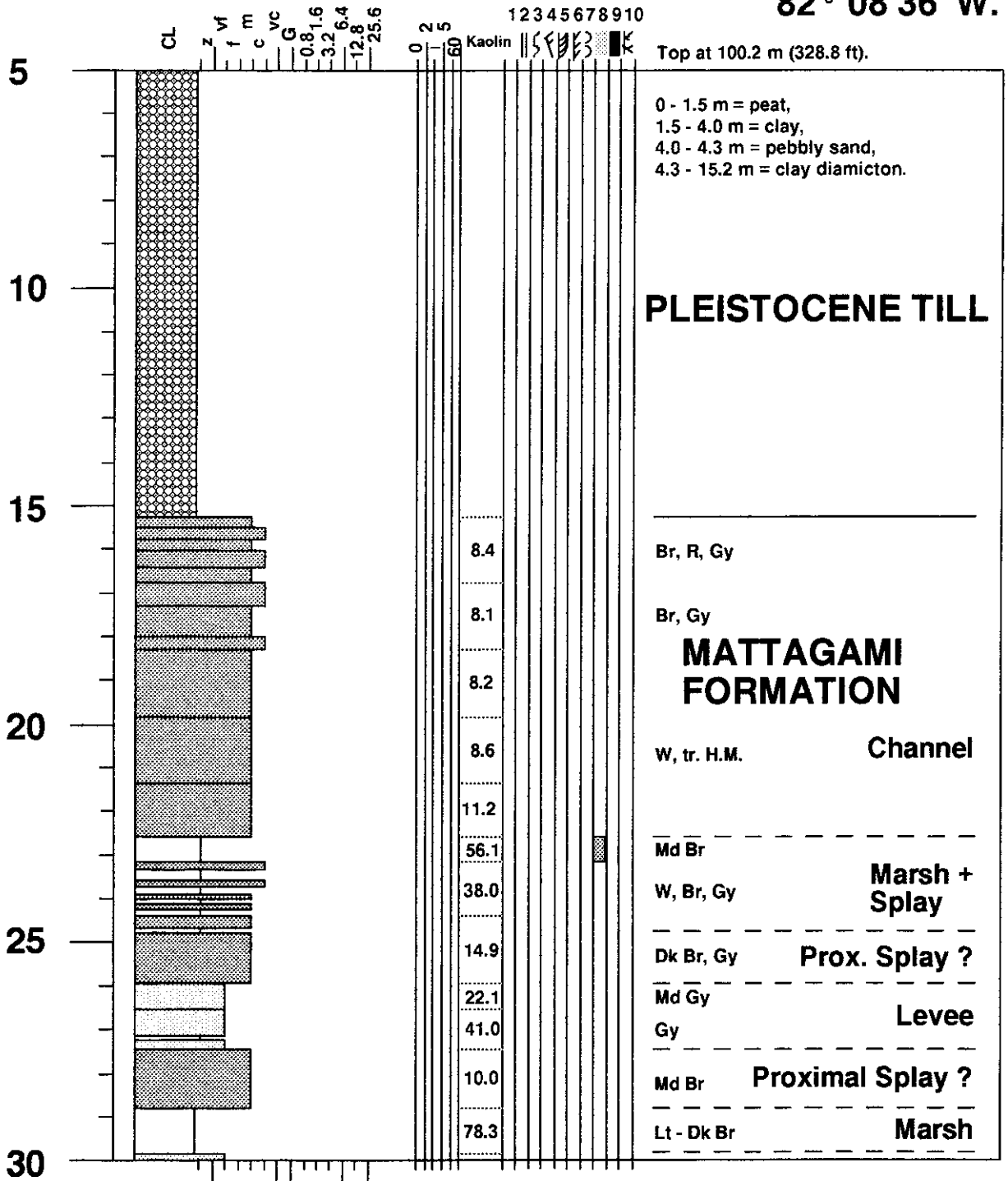
MRC hole 89 - 91, Kipling Twp.

50° 08'50"N,
82° 08'36"W.



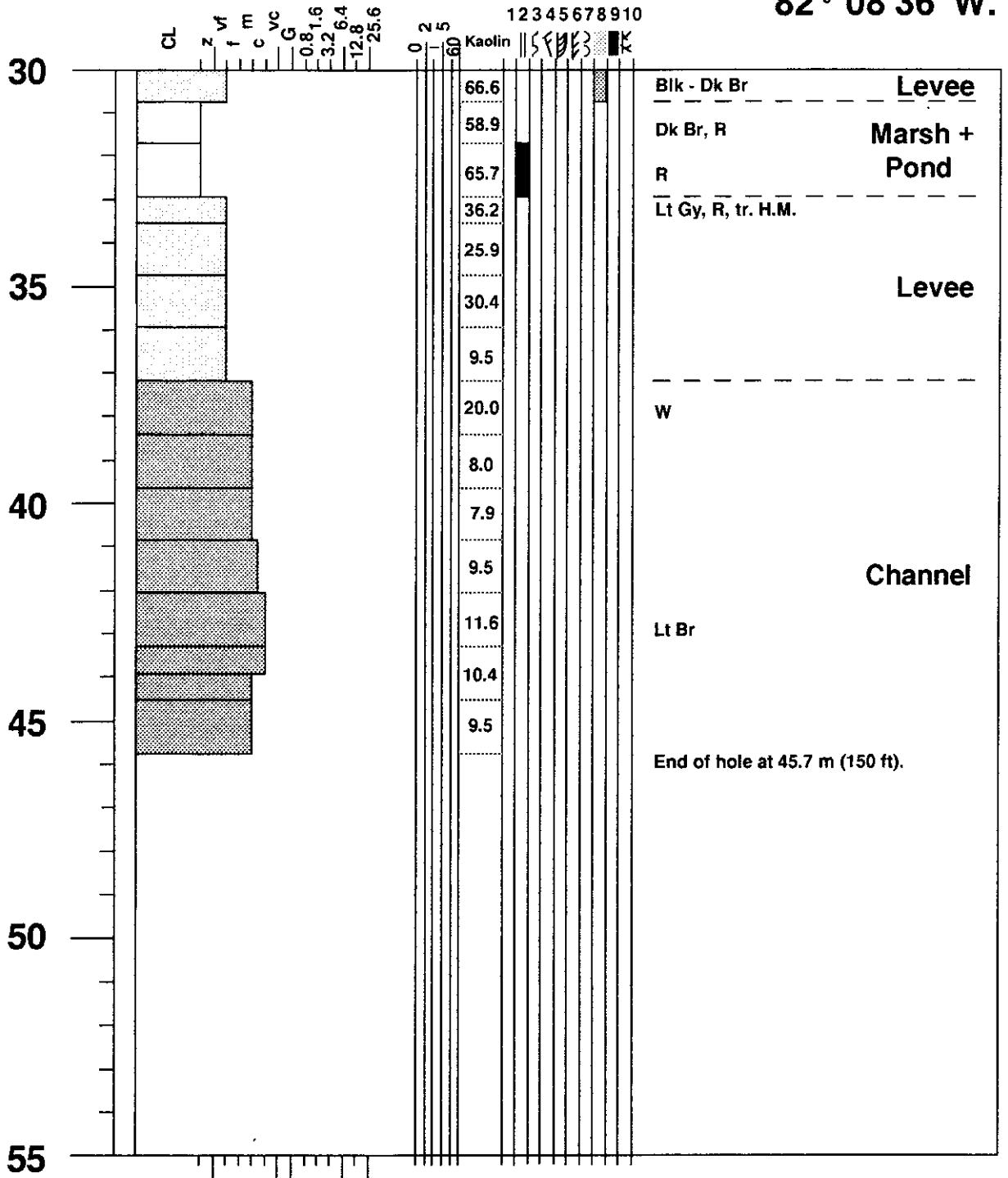
MRC hole 89 - 92, Kipling Twp.

50° 08'44"N,
82° 08'36"W.



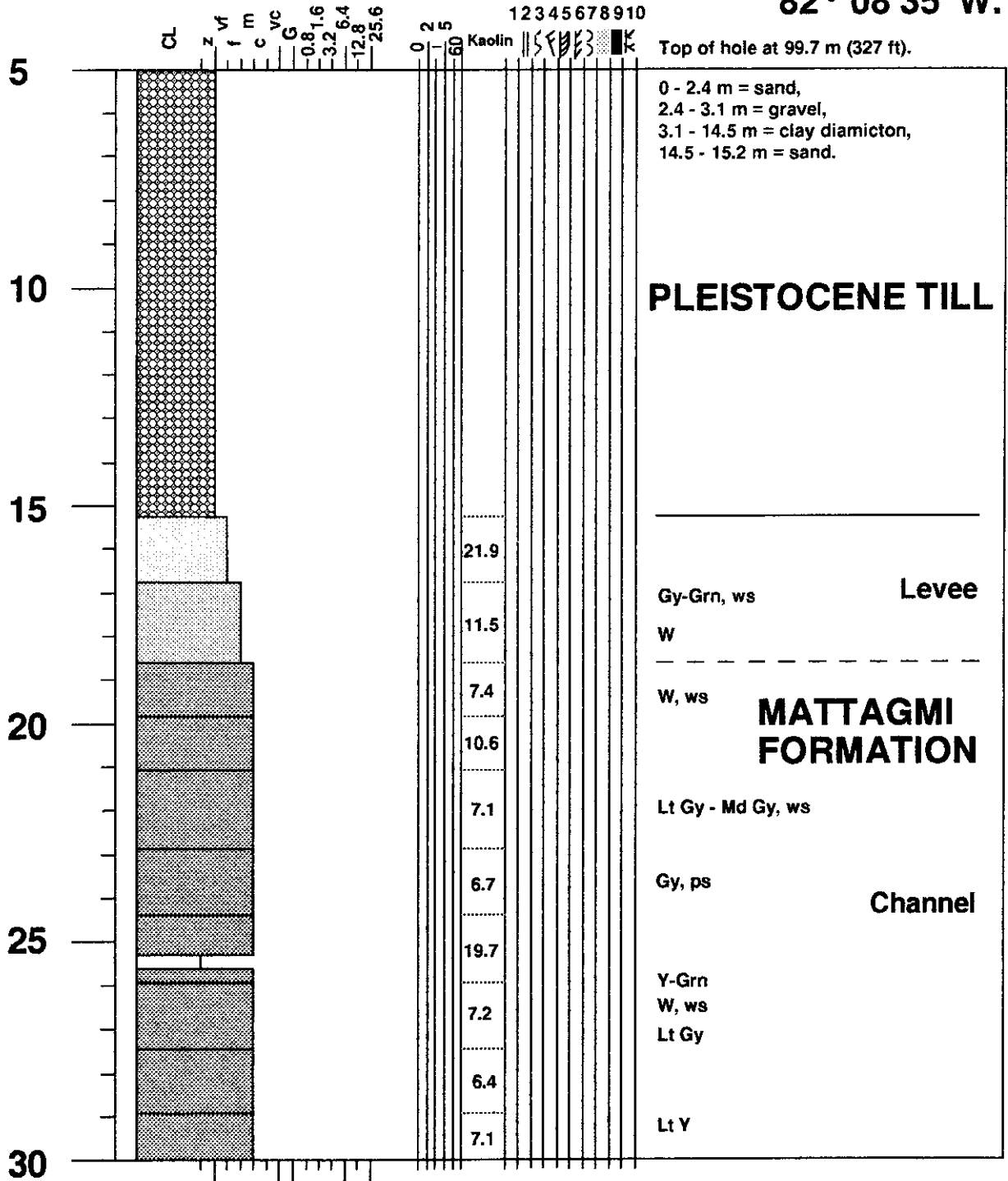
MRC hole 89 - 92, Kipling Twp.

50° 08'44"N,
82° 08'36"W.



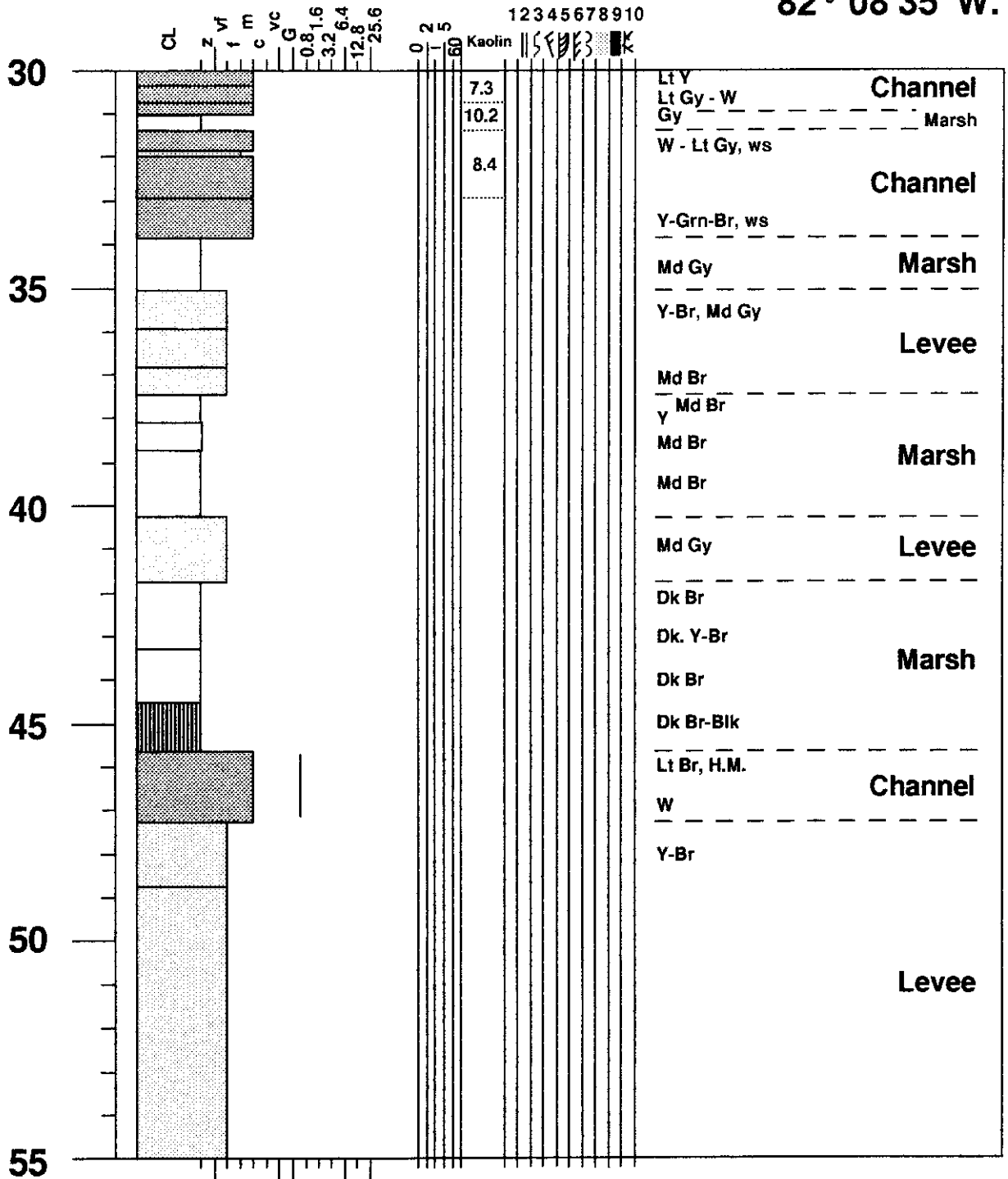
MRC hole 89 - 95, Kipling Twp.

50° 08'51"N,
82° 08'35"W.



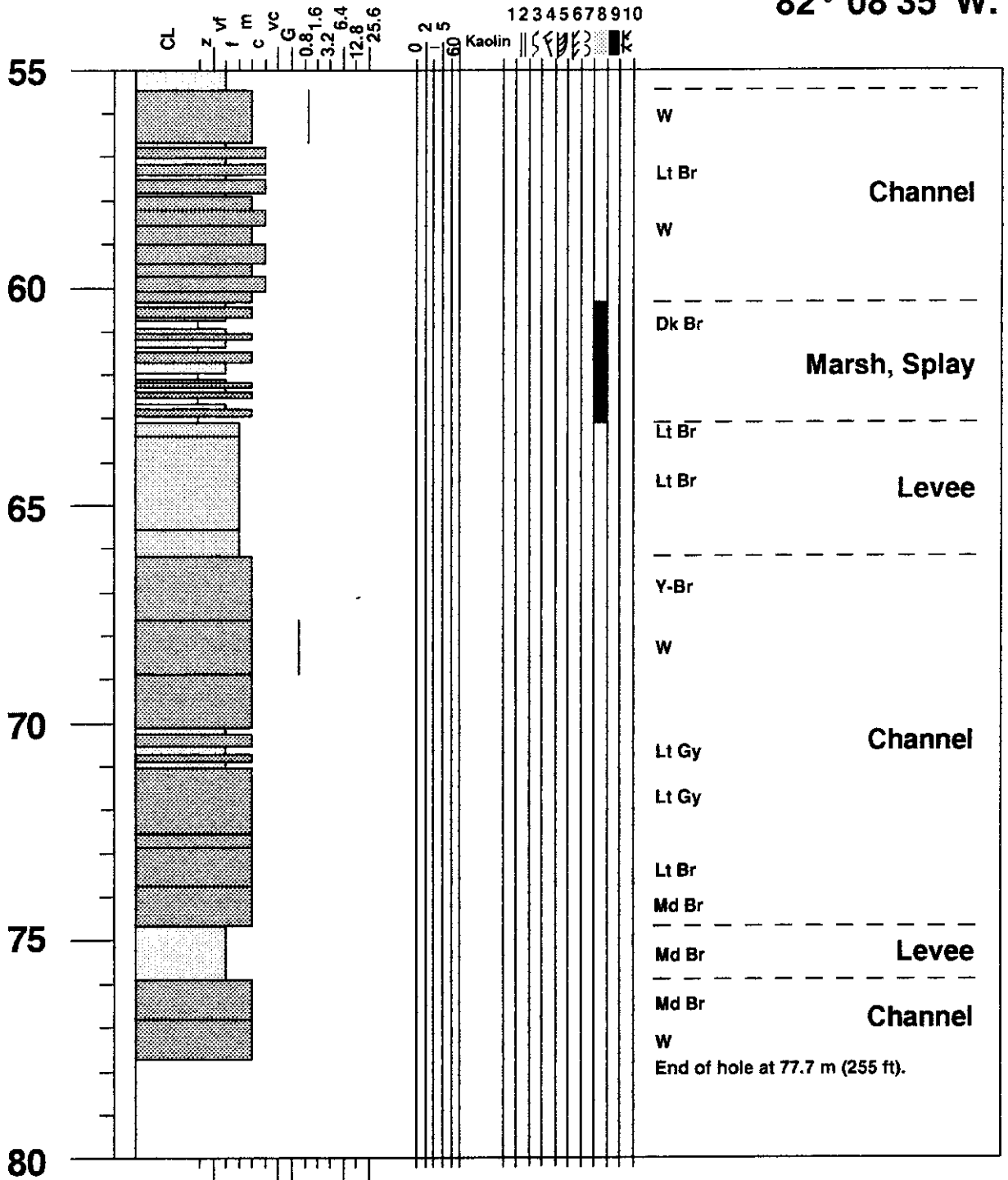
MRC hole 89 - 95, Kipling Twp.

50° 08'51"N,
82° 08'35"W.



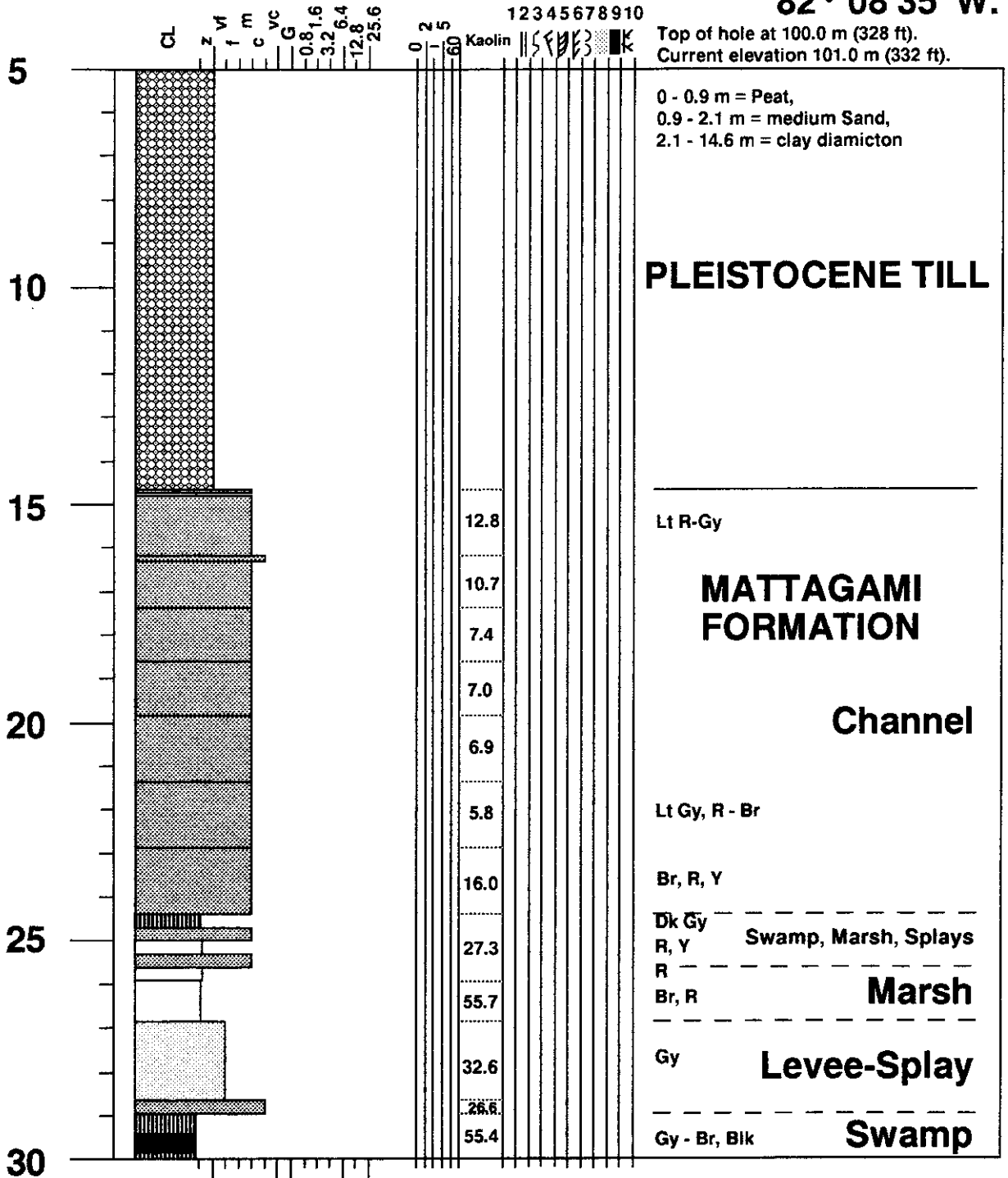
MRC hole 89 - 95, Kipling Twp.

50° 08'51"N,
82° 08'35"W.



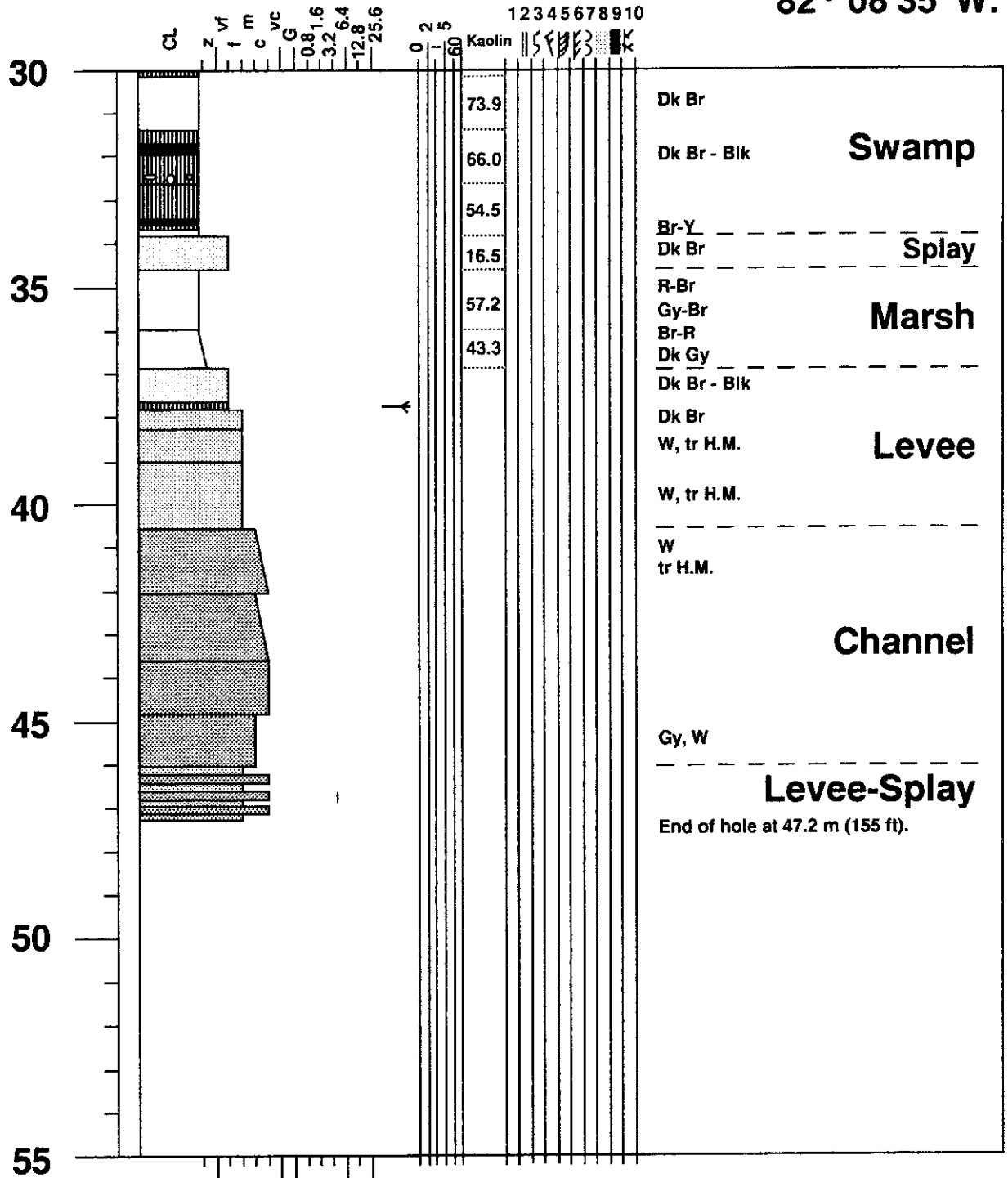
MRC hole 89 - 97, Kipling Twp.

50° 08'46"N,
82° 08'35"W.



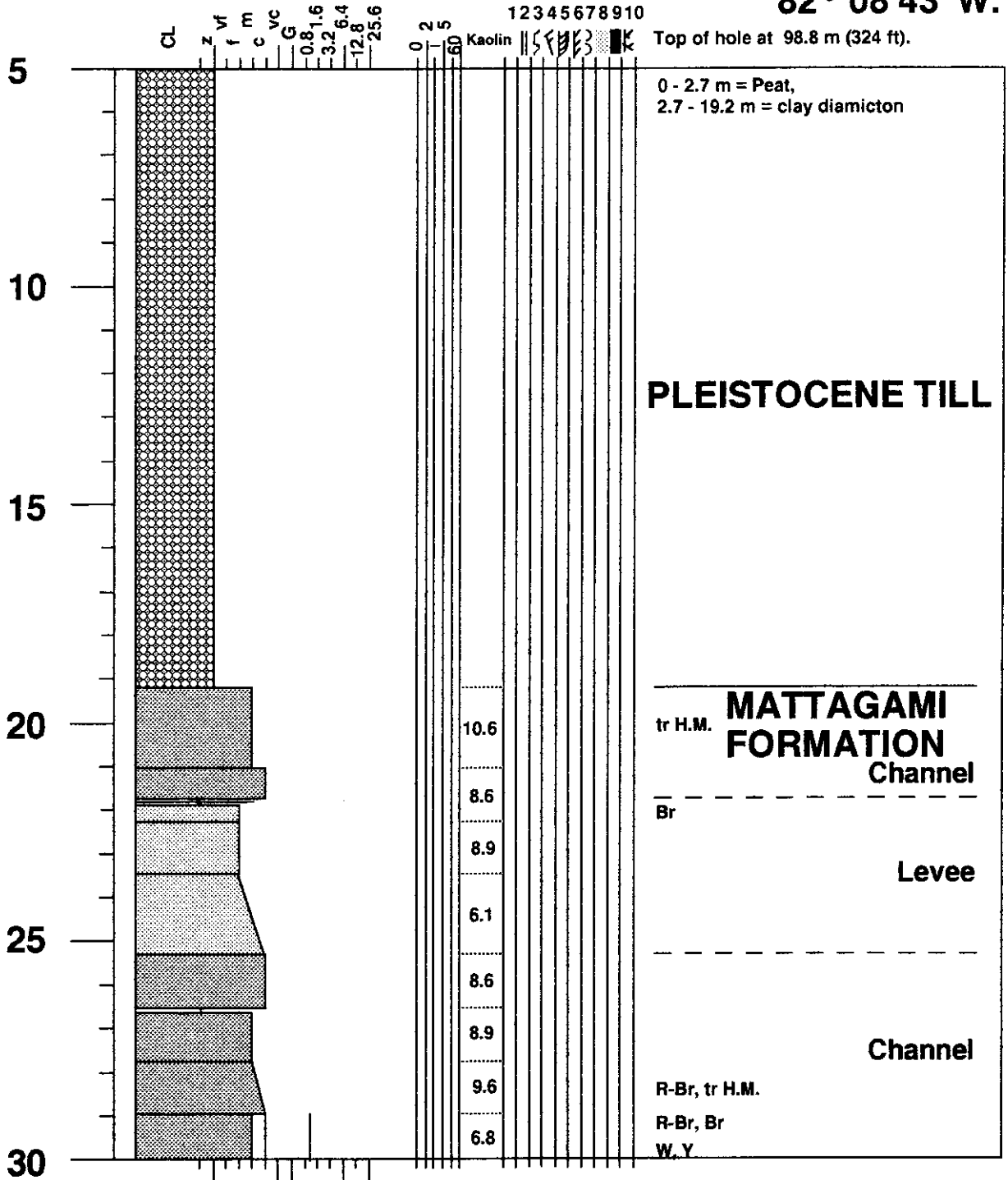
MRC hole 89 - 97, Kipling Twp.

50° 08'46"N,
82° 08'35"W.



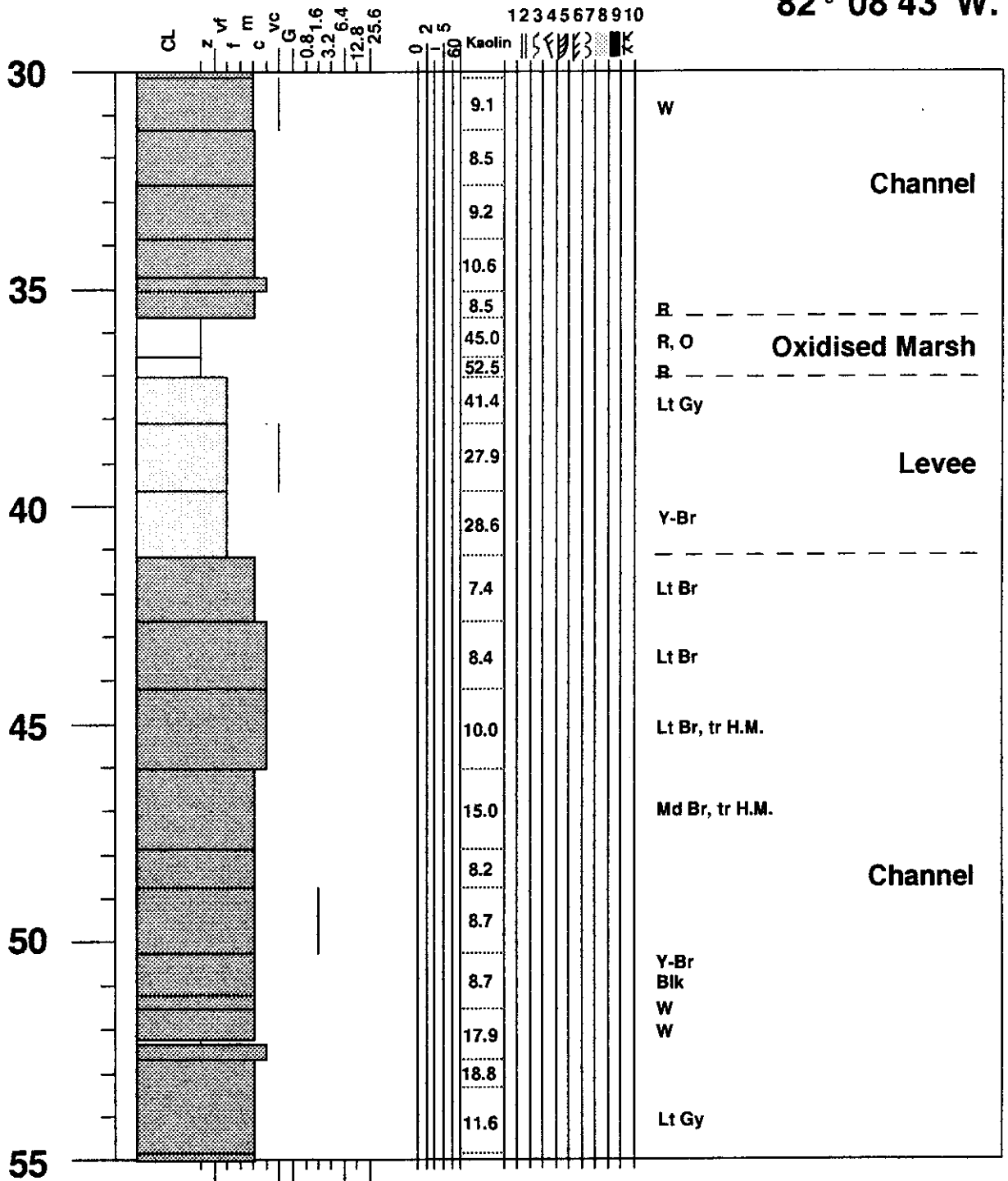
MRC hole 89 - 98, Kipling Twp.

50° 08'42"N,
82° 08'43"W.



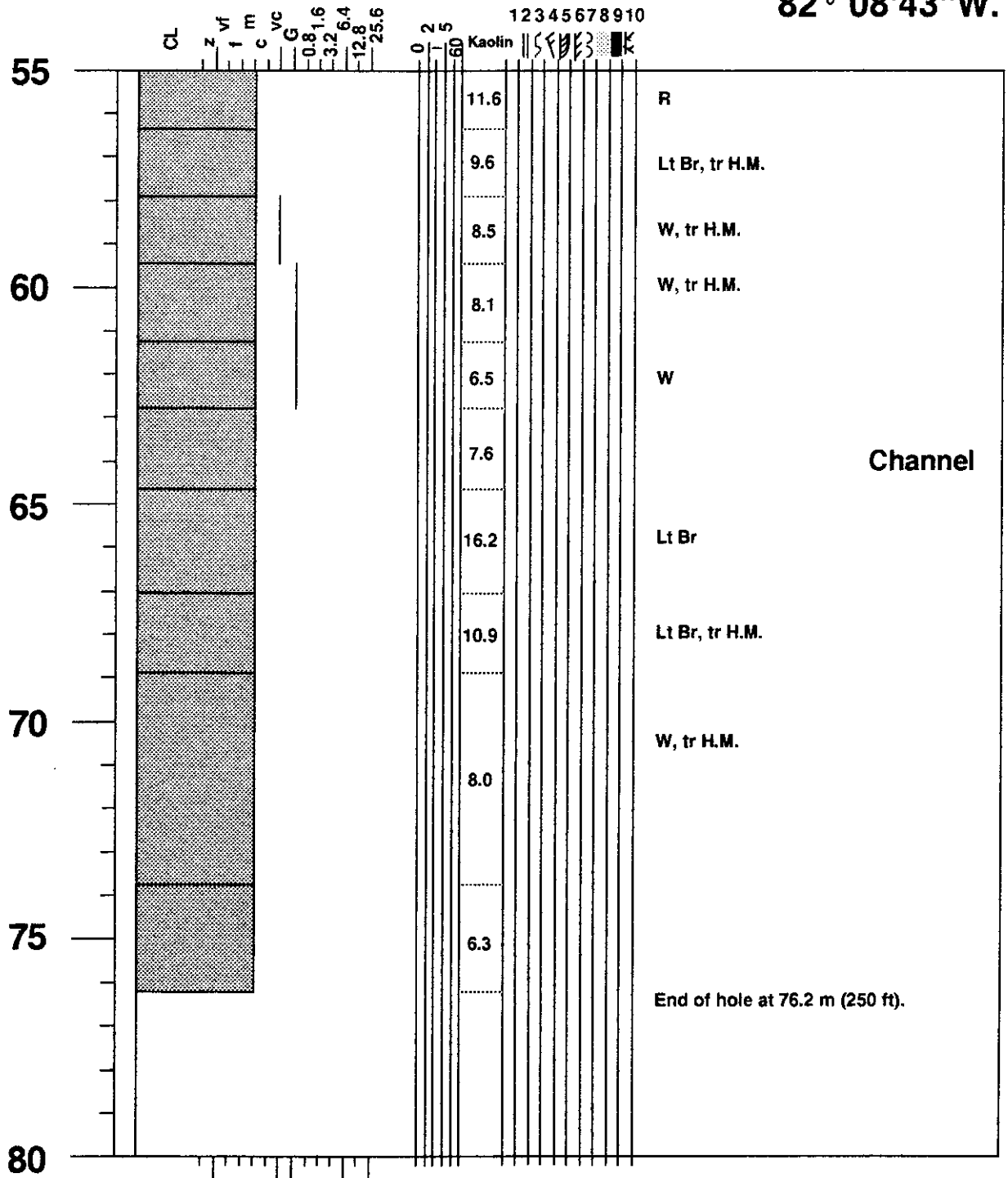
MRC hole 89 - 98, Kipling Twp.

50° 08'42"N,
82° 08'43"W.



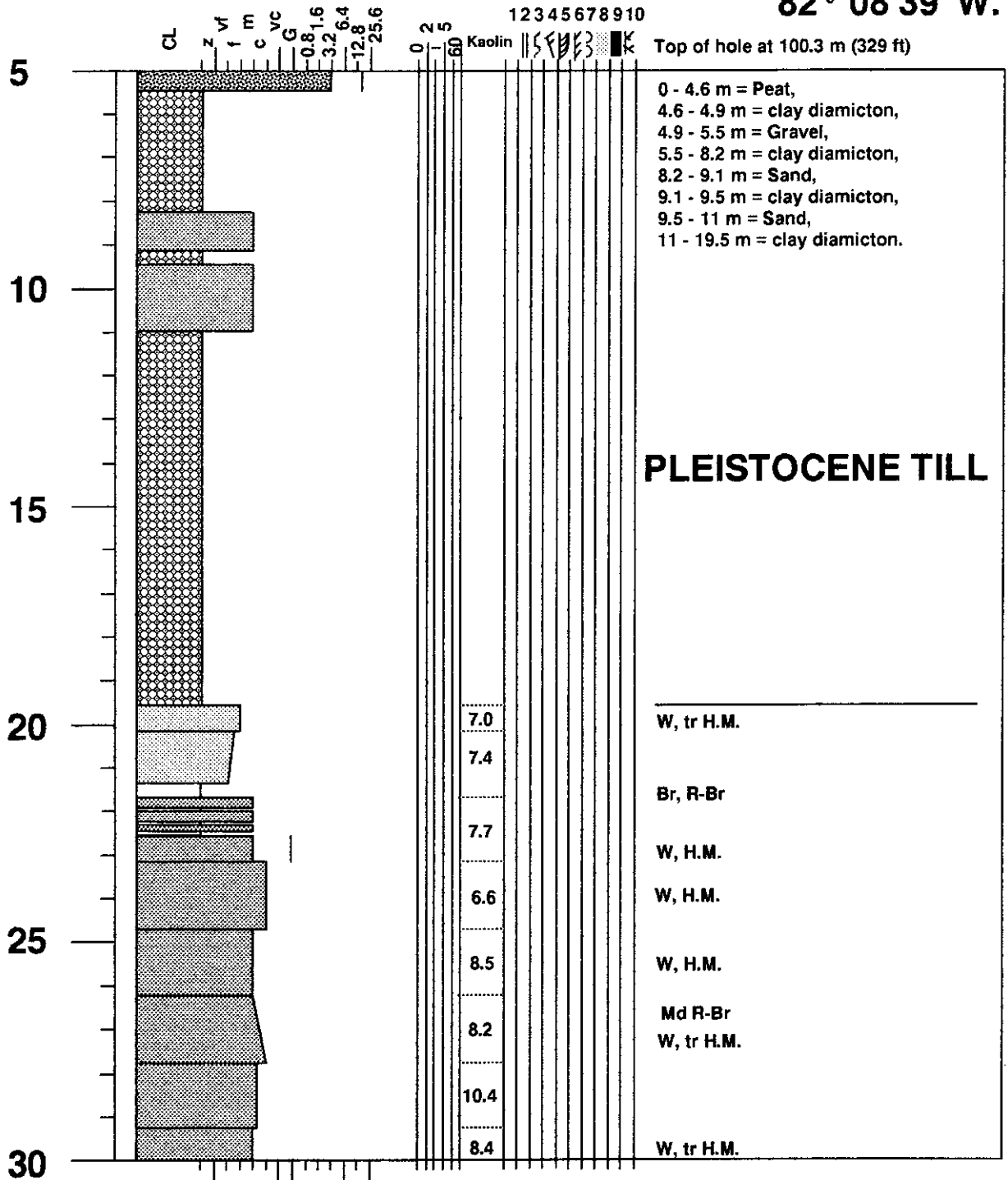
MRC hole 89 - 98, Kipling Twp.

50° 08'42"N,
82° 08'43"W.



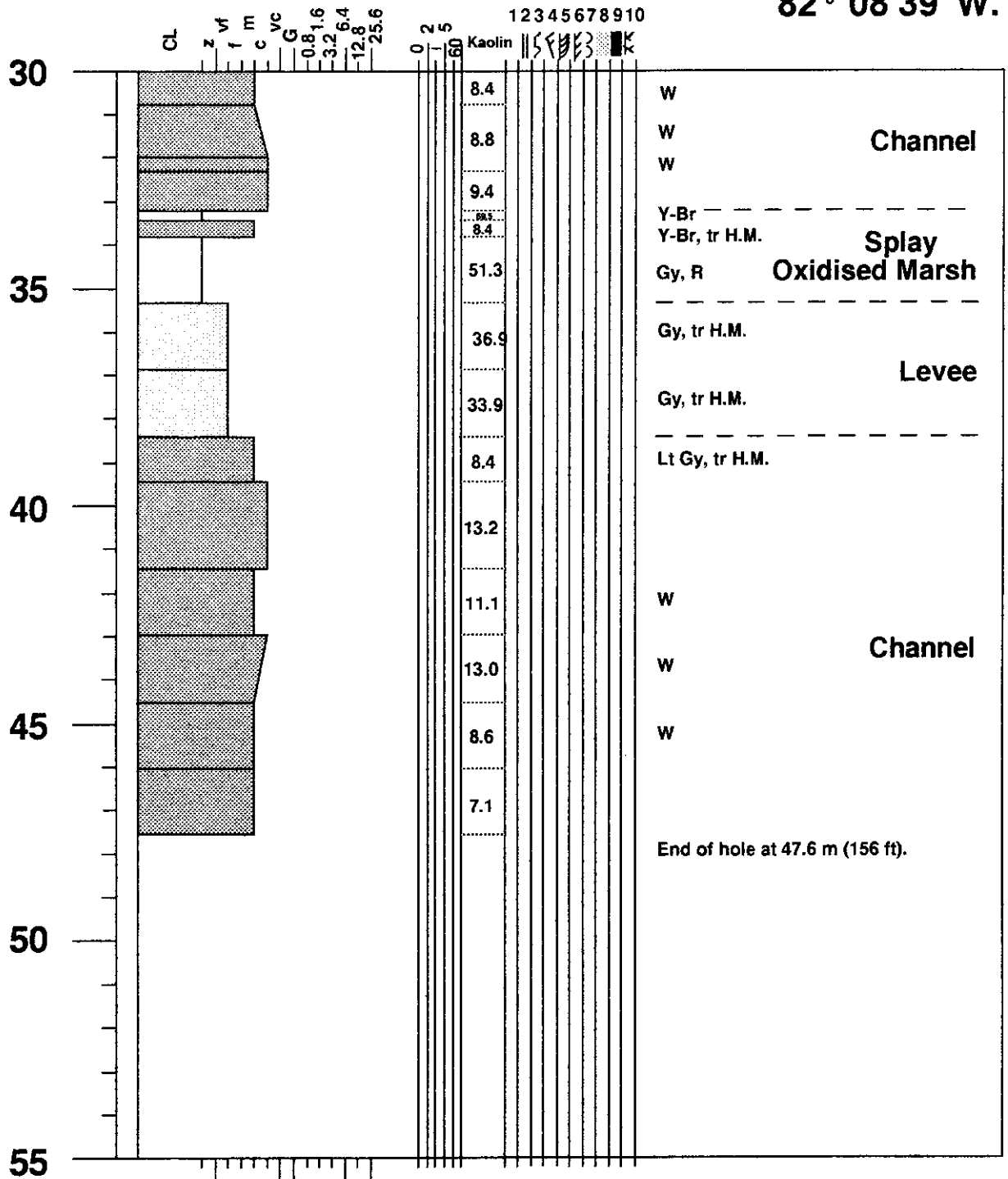
MRC hole 89 - 99, Kipling Twp.

50° 08'41"N,
82° 08'39"W.



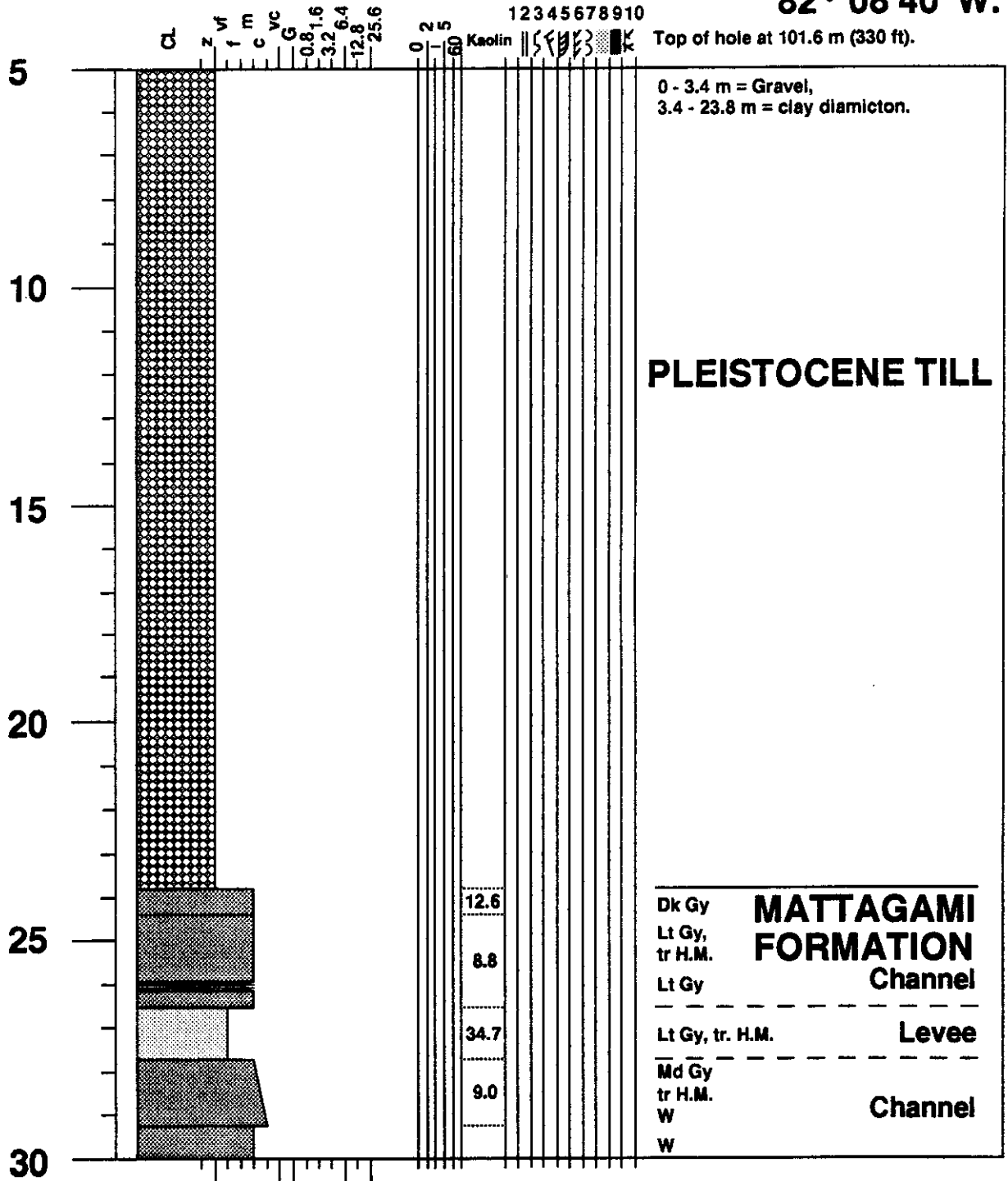
MRC hole 89 - 99, Kipling Twp.

50° 08'41"N,
82° 08'39"W.



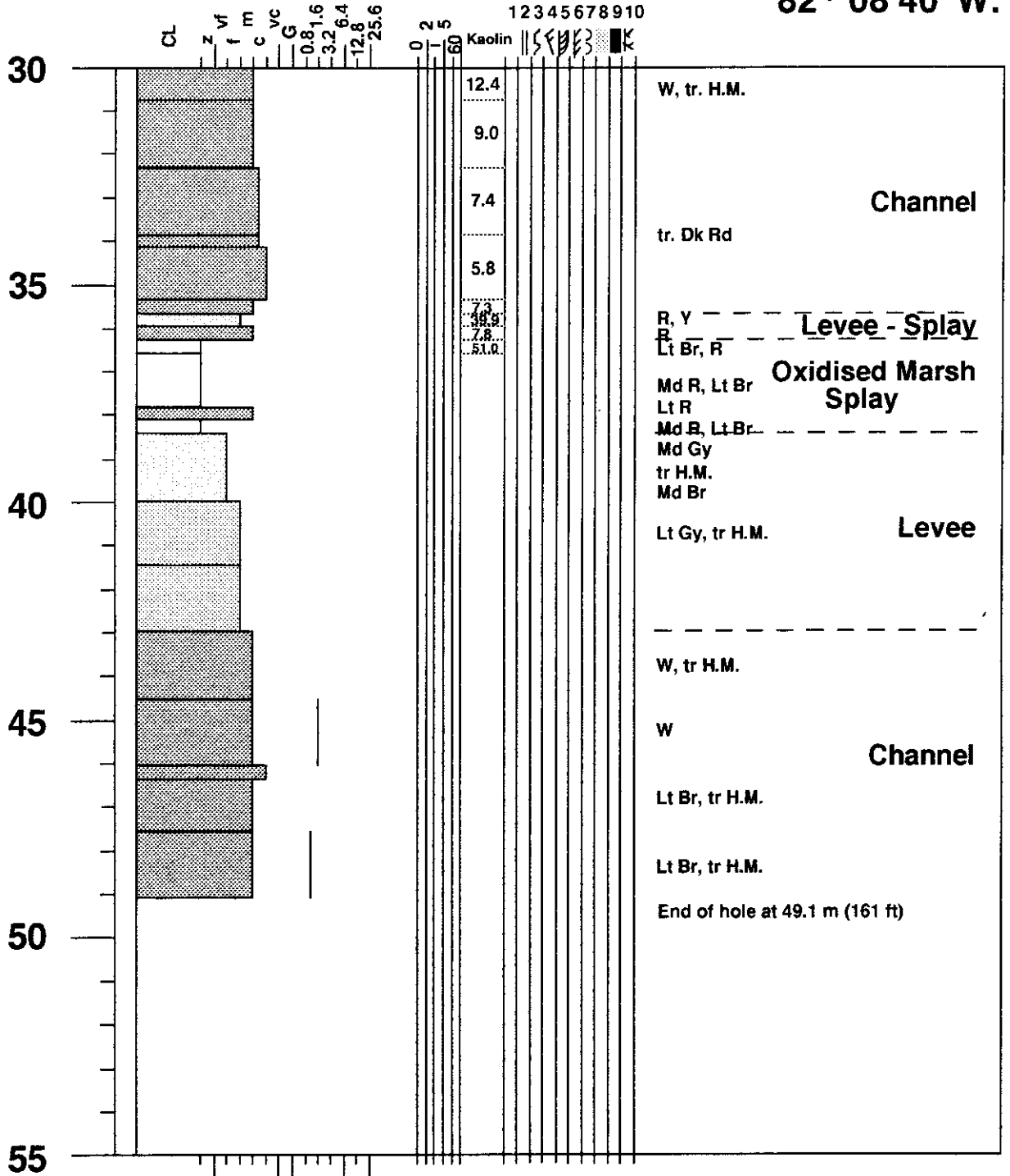
MRC hole 89 - 101, Kipling Twp.

50° 08'41"N,
82° 08'40"W.



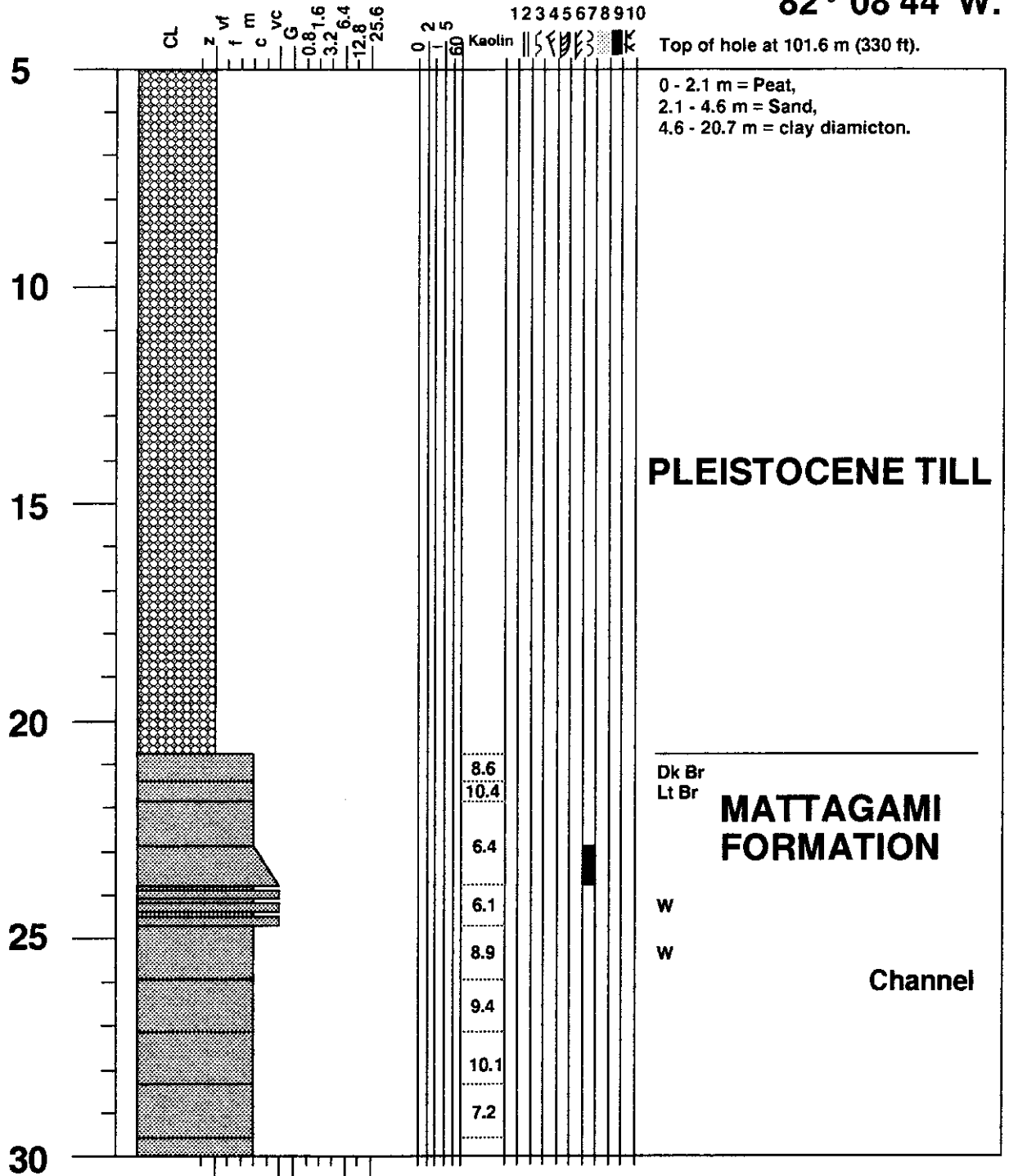
MRC hole 89 - 101, Kipling Twp.

50° 08'41"N,
82° 08'40"W.



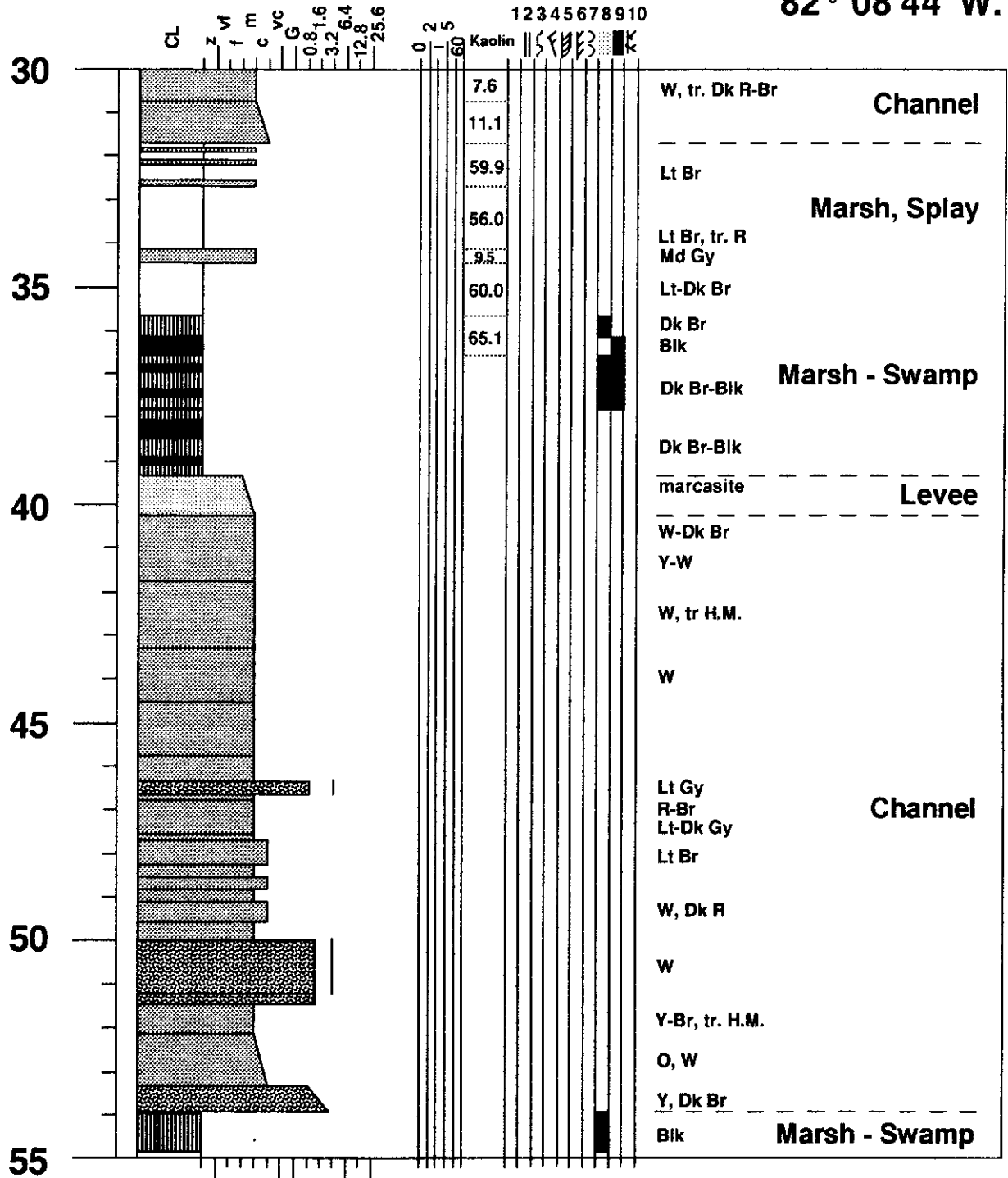
MRC hole 89 - 103, Kipling Twp.

50° 08'39"N,
82° 08'44"W.



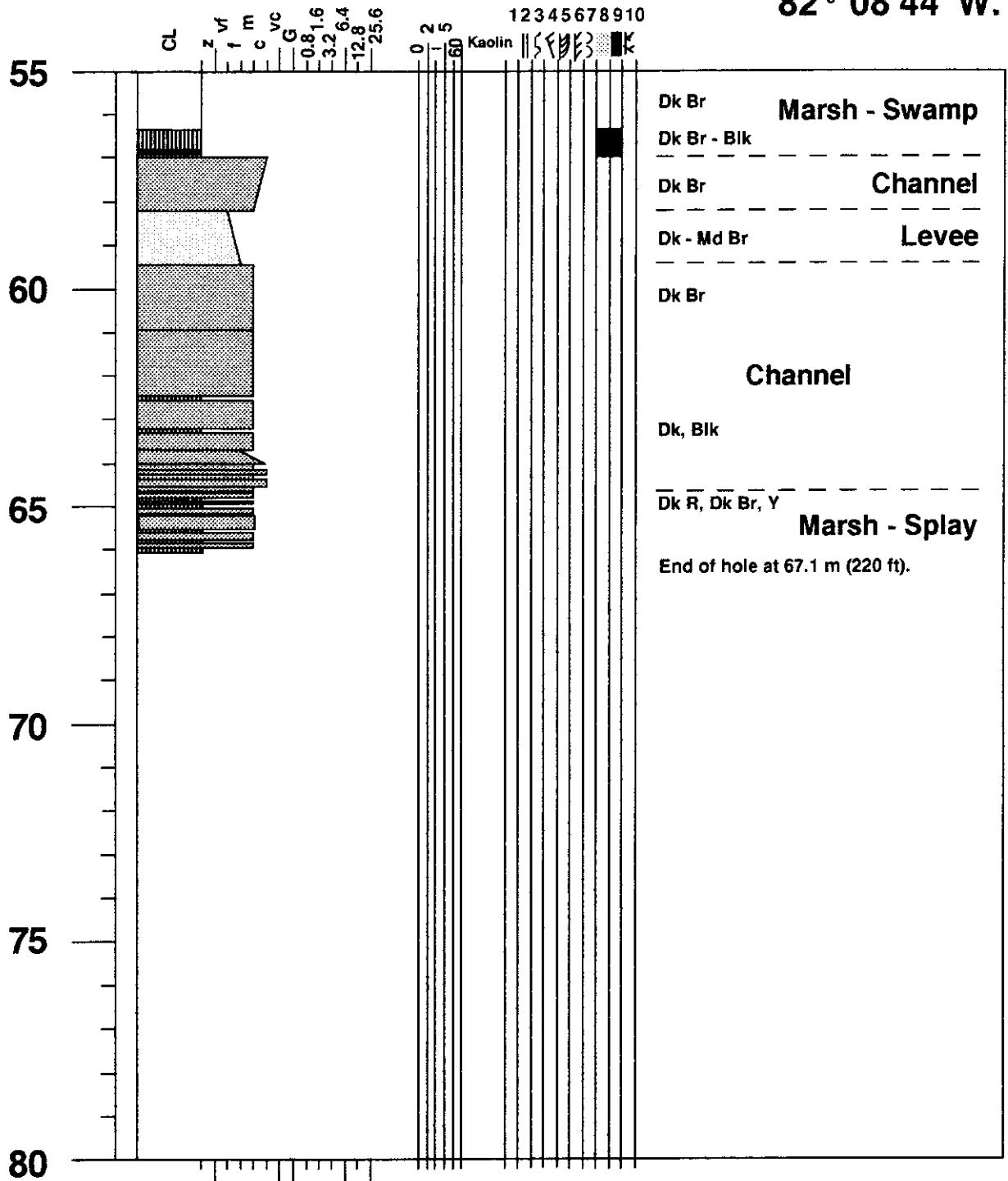
MRC hole 89 - 103, Kipling Twp.

50° 08'39"N,
82° 08'44"W.



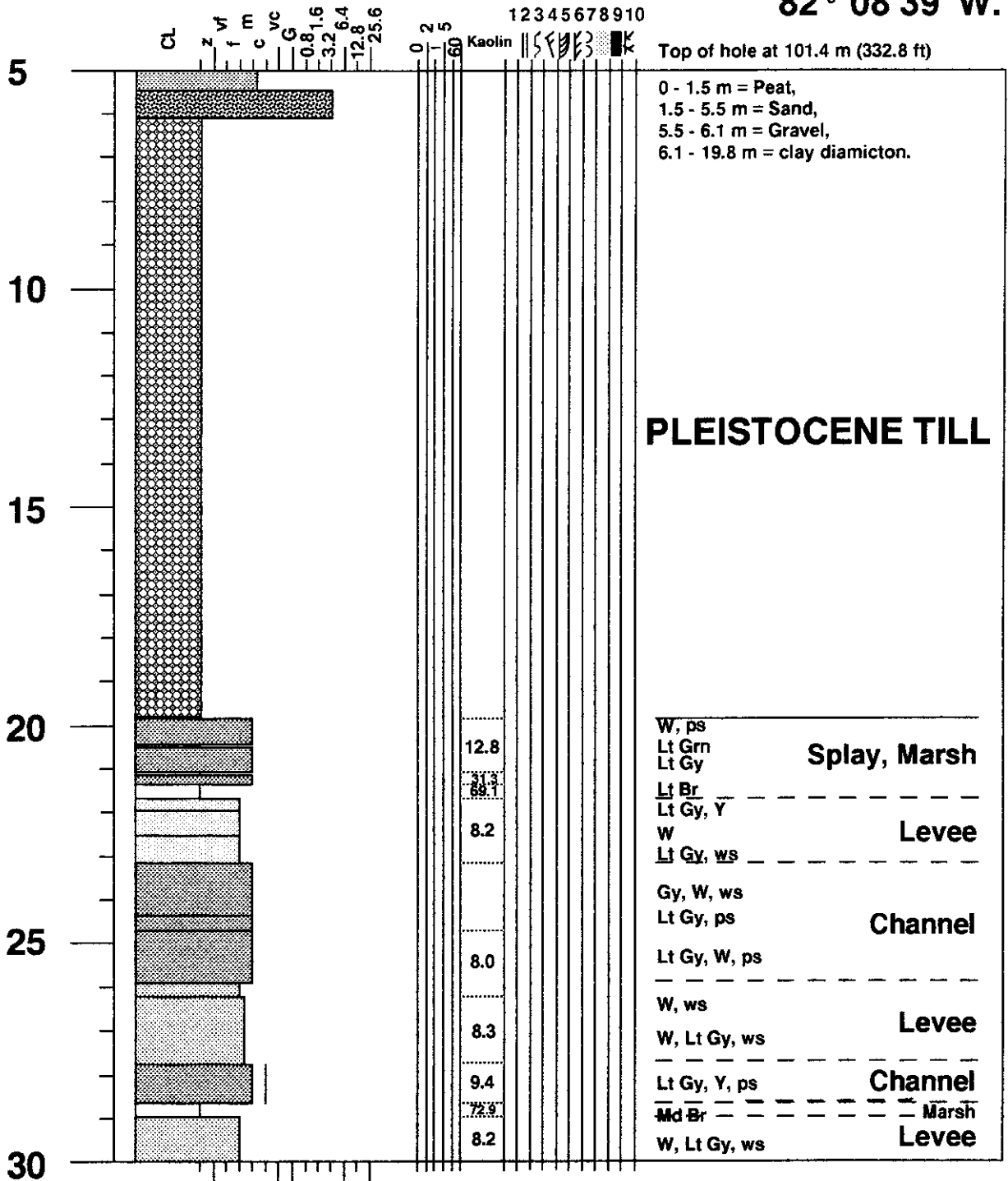
MRC hole 89 - 103, Kipling Twp.

50° 08'39"N,
82° 08'44"W.



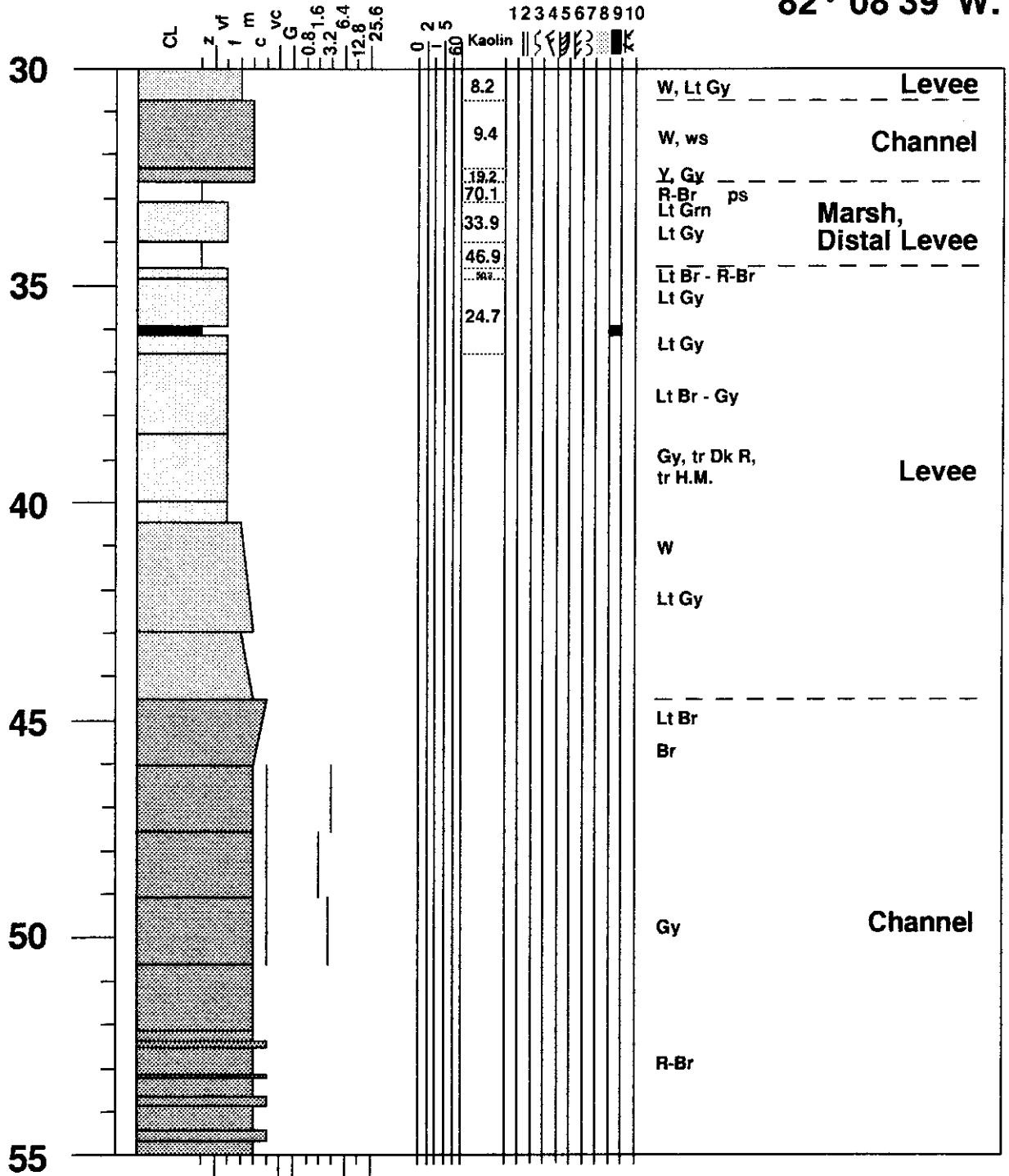
MRC hole 89 - 104, Kipling Twp.

50° 08'39"N,
82° 08'39"W.



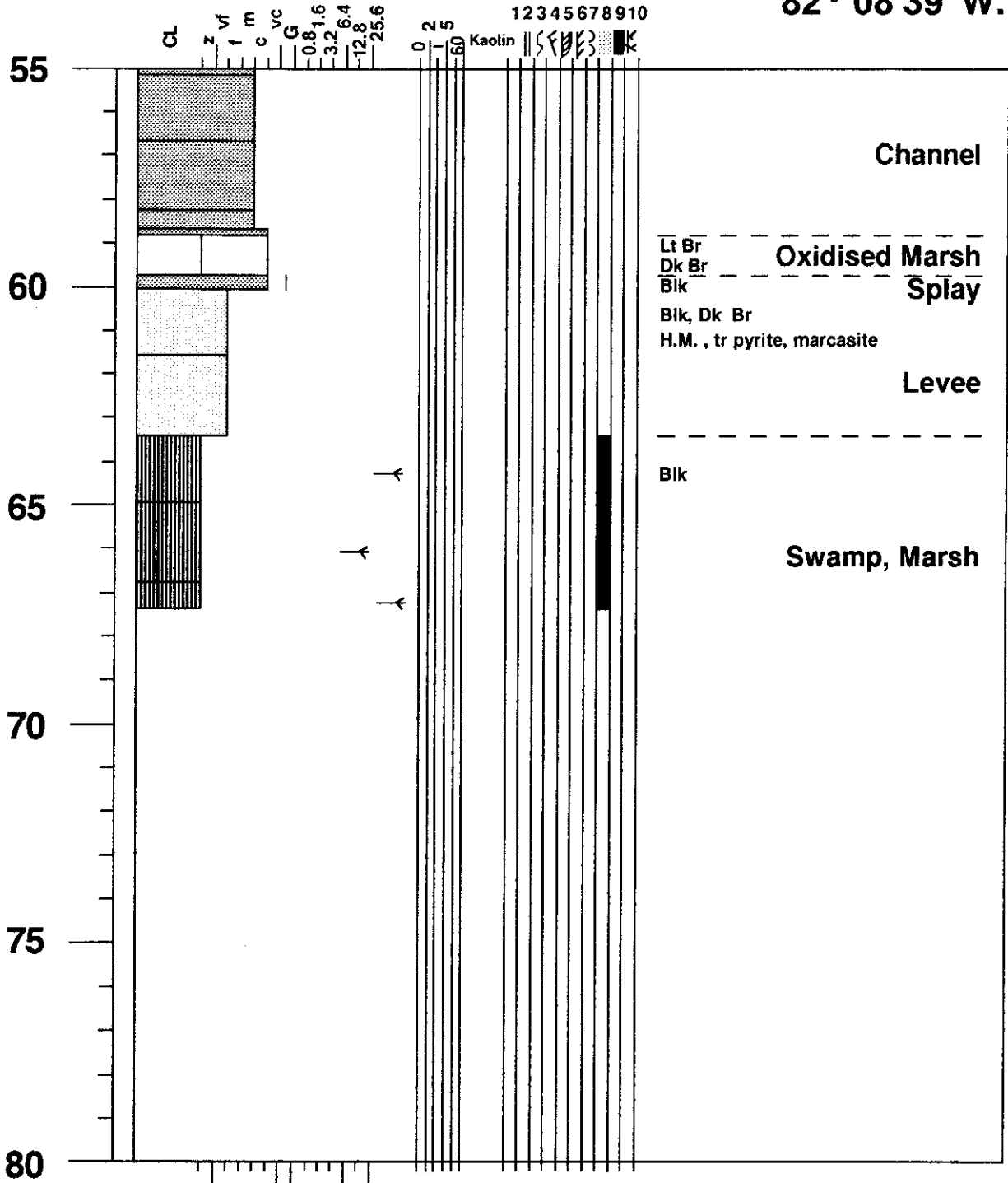
MRC hole 89 - 104, Kipling Twp.

50° 08'39"N,
82° 08'39"W.



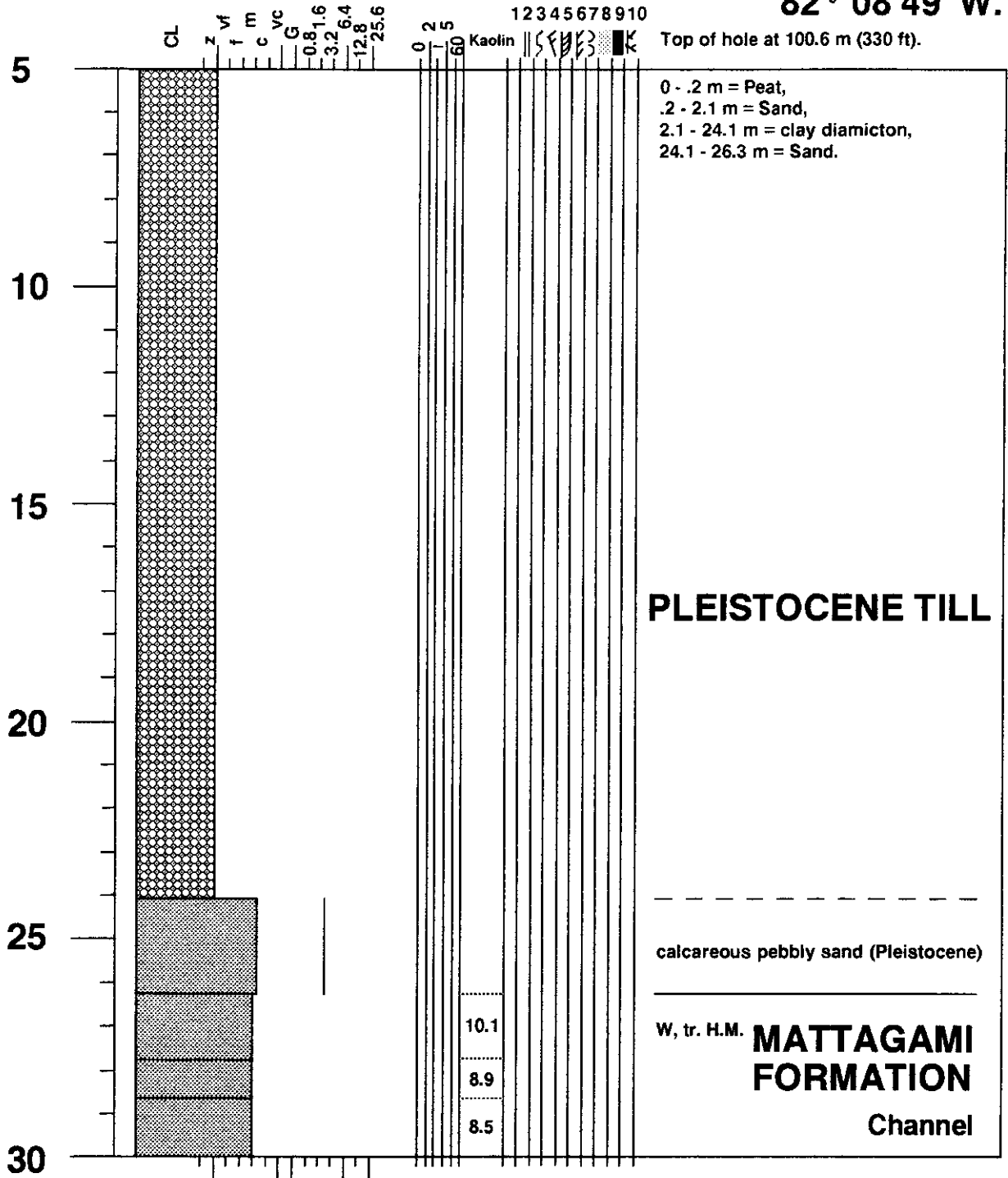
MRC hole 89 - 104, Kipling Twp.

50° 08'39"N,
82° 08'39"W.



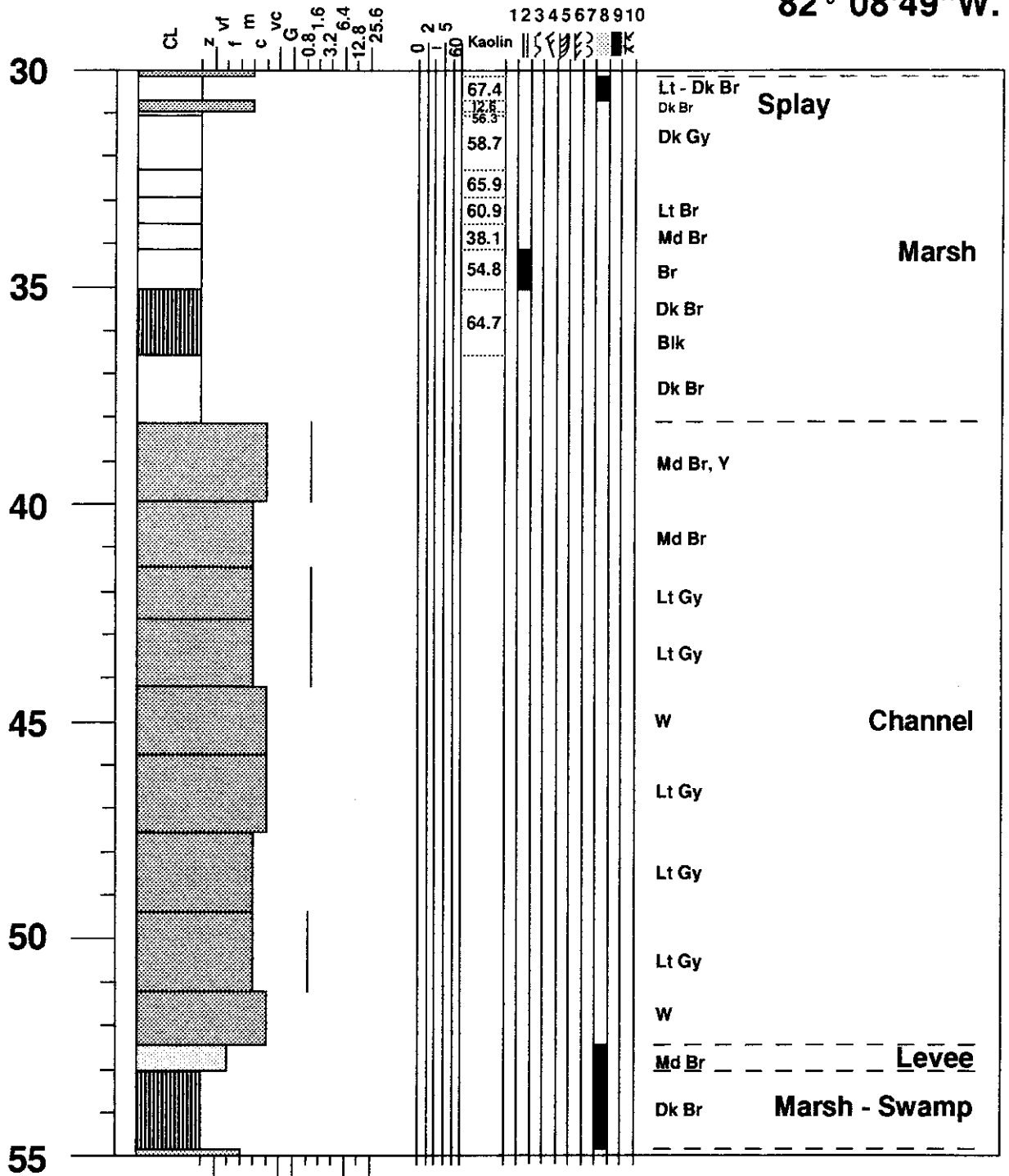
MRC hole 89 - 106 , Kipling Twp.

50° 08'37"N,
82° 08'49"W.



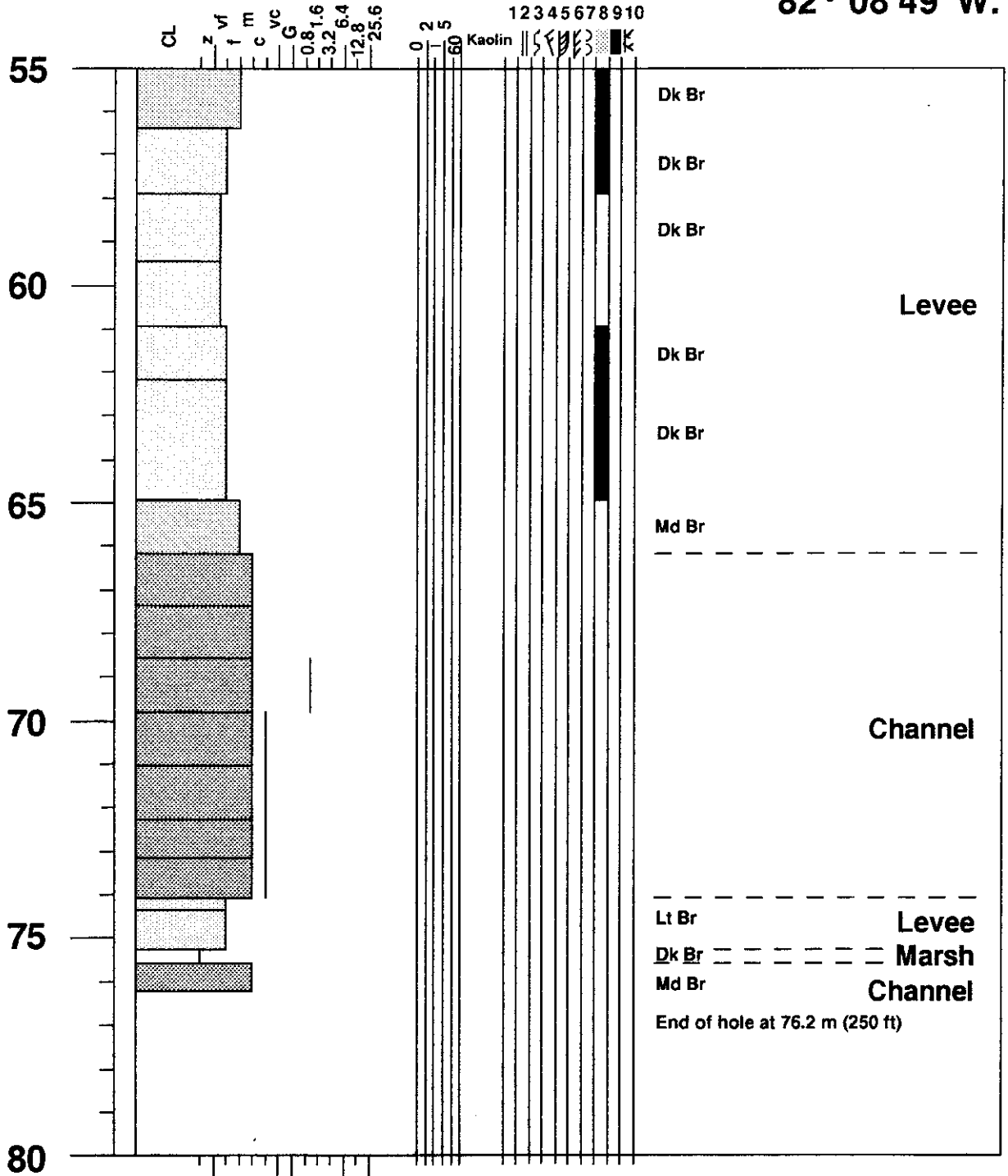
MRC hole 89 - 106 , Kipling Twp.

50° 08'37"N,
82° 08'49"W.



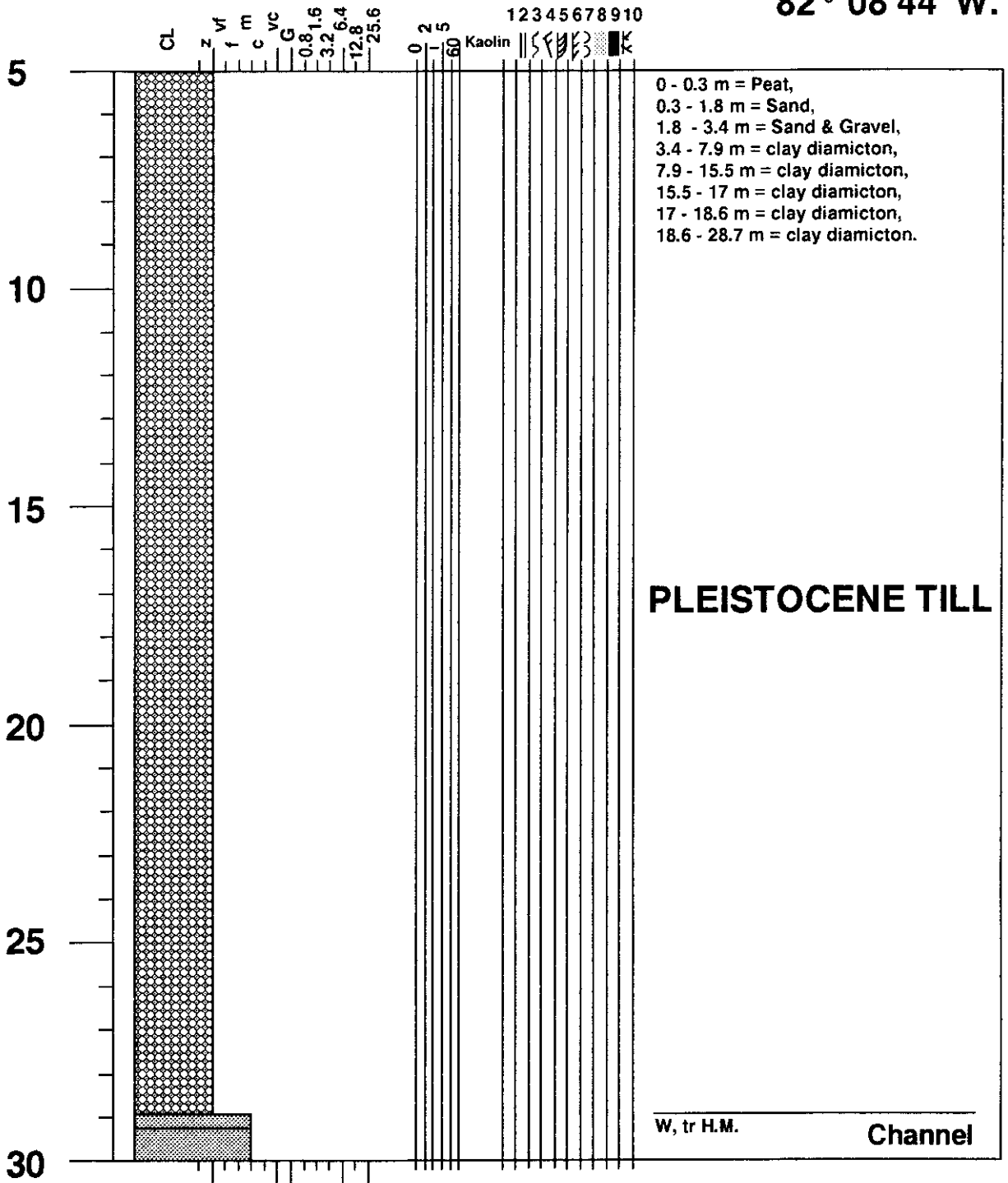
MRC hole 89 - 106 , Kipling Twp.

50° 08'37"N,
82° 08'49"W.



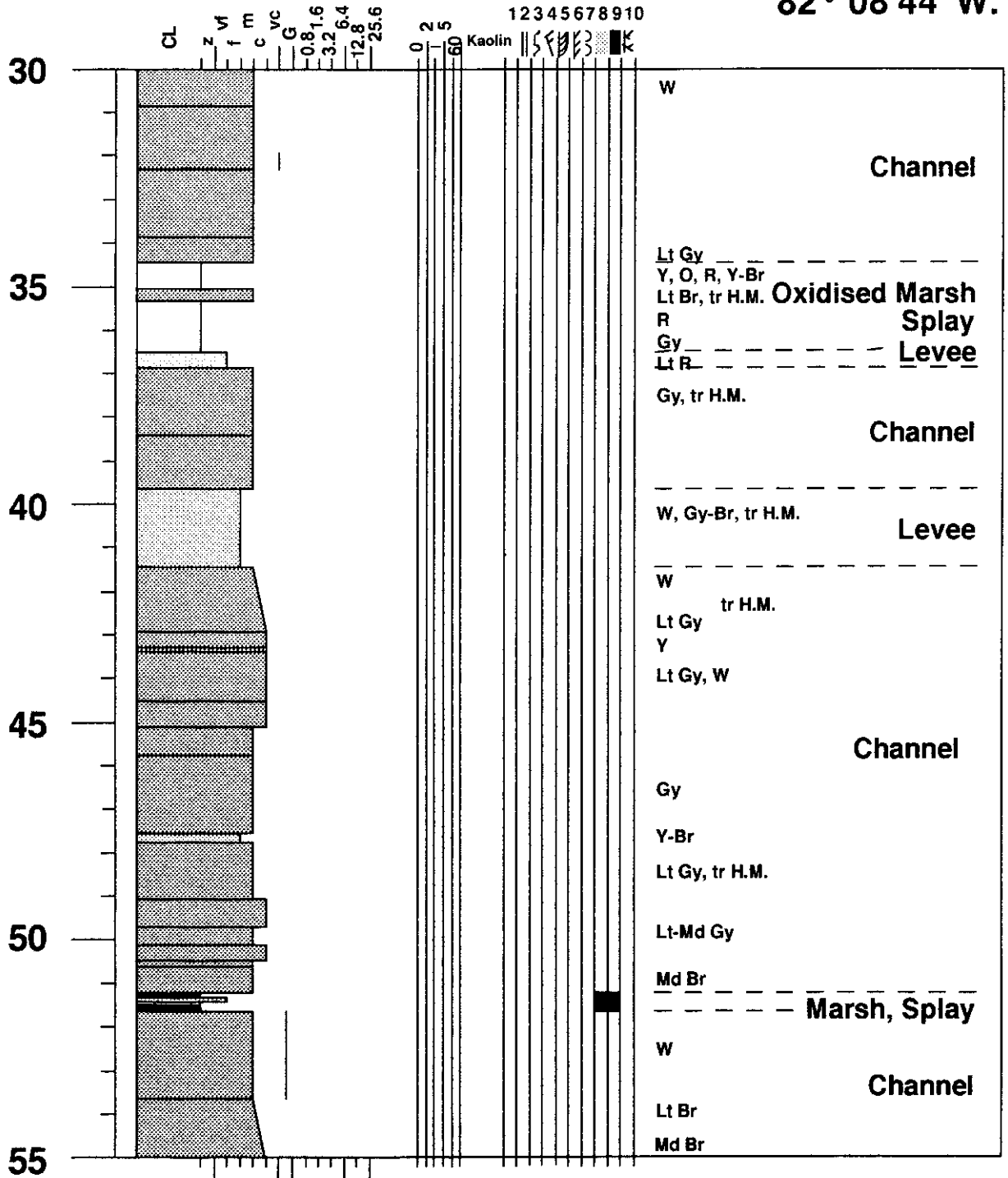
MRC hole 89 - 113, Kipling Twp.

50° 08'34"N,
82° 08'44"W.



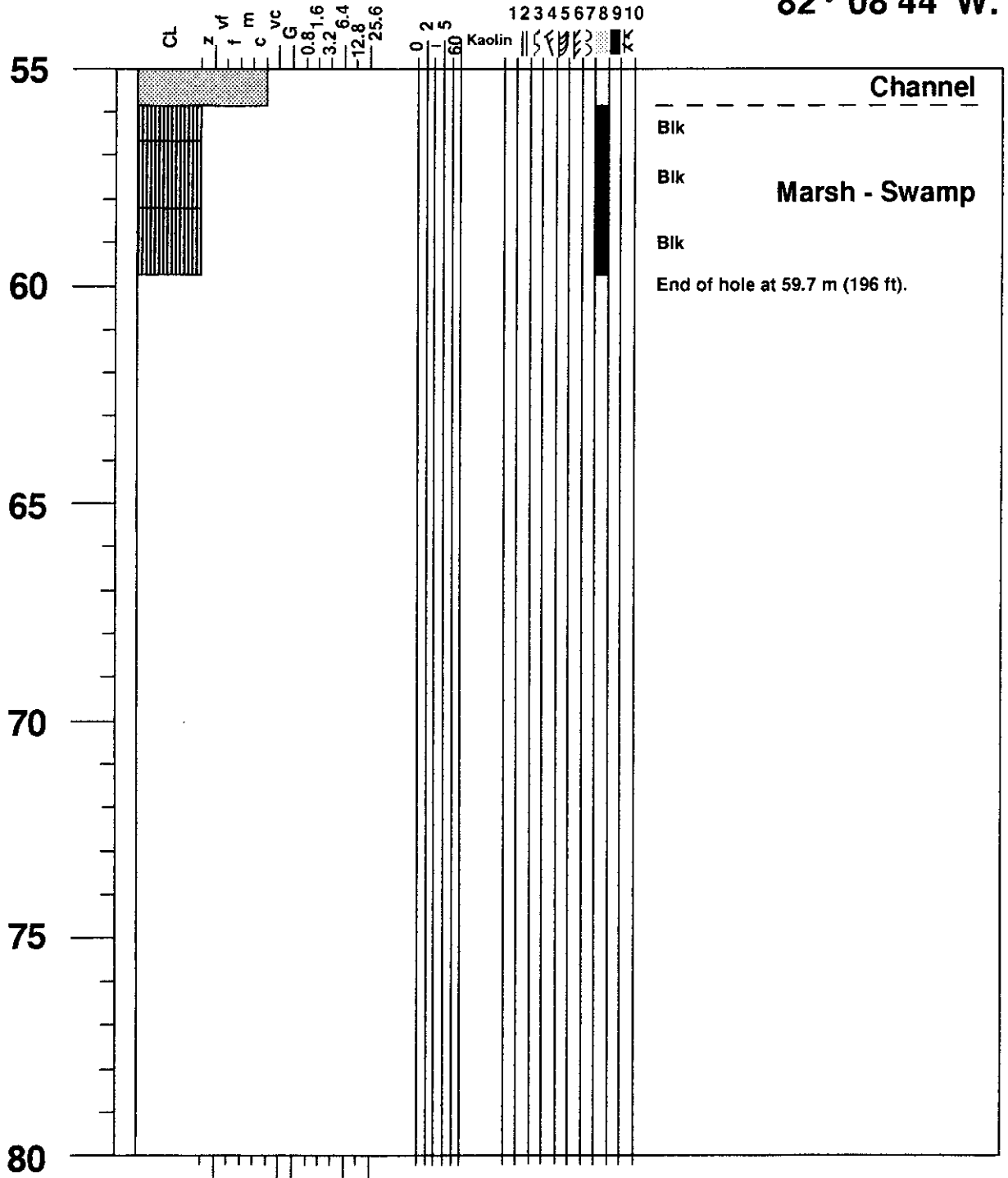
MRC hole 89 - 113, Kipling Twp.

50° 08'34"N,
82° 08'44"W.



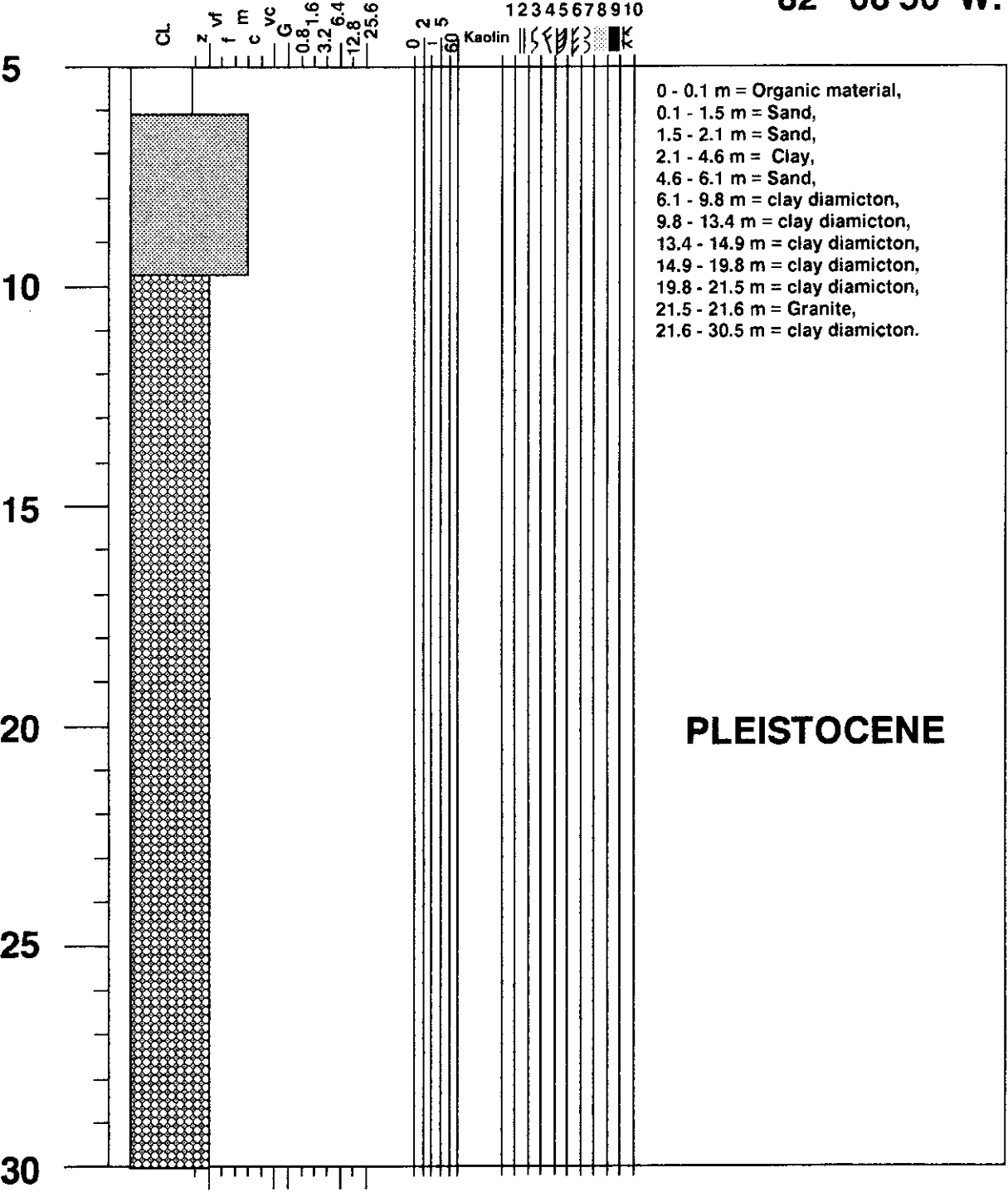
MRC hole 89 - 113, Kipling Twp.

**50° 08'34"N,
82° 08'44"W.**



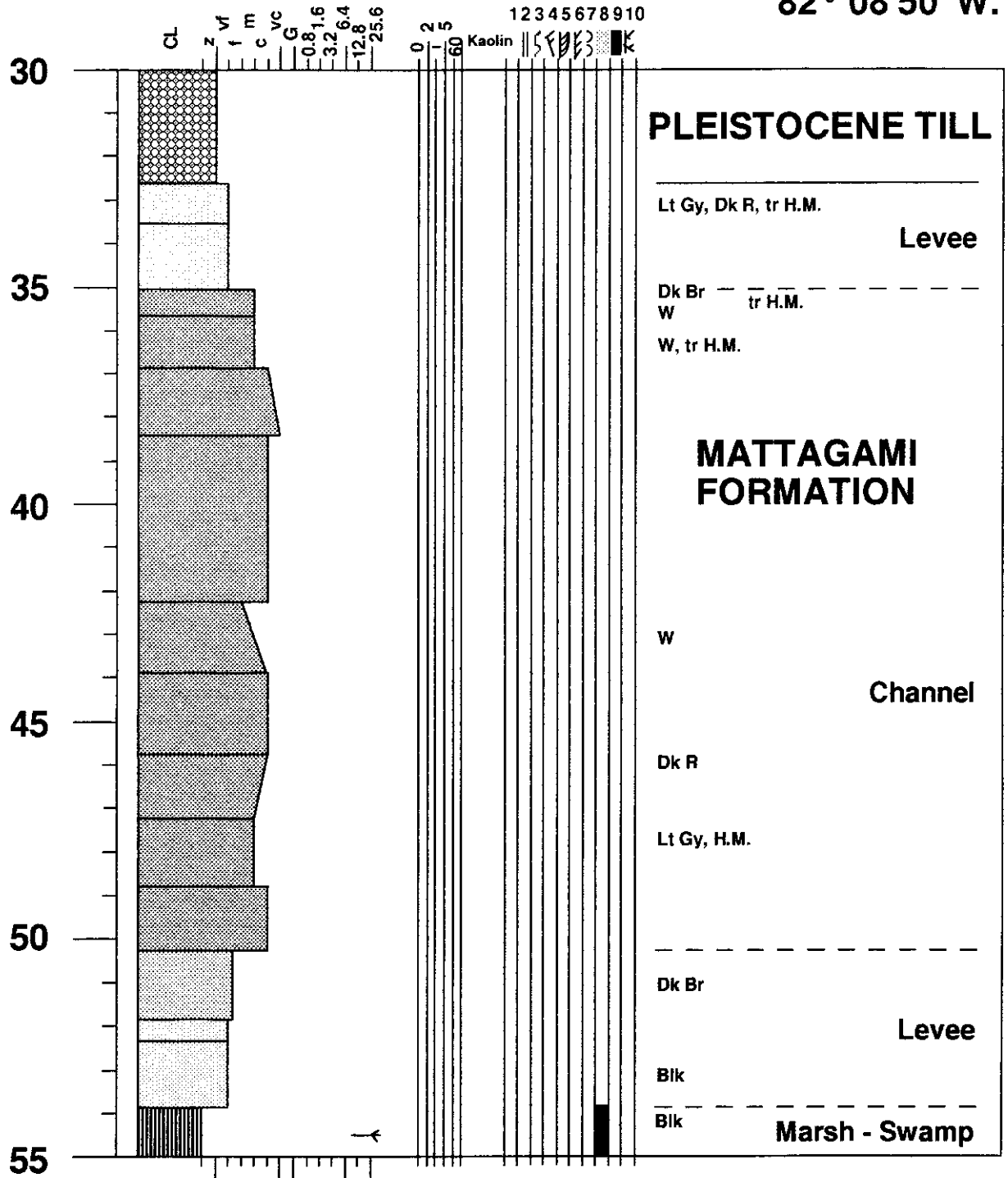
MRC hole 89 - 114, Kipling Twp.

50° 08'32"N,
82° 08'50"W.



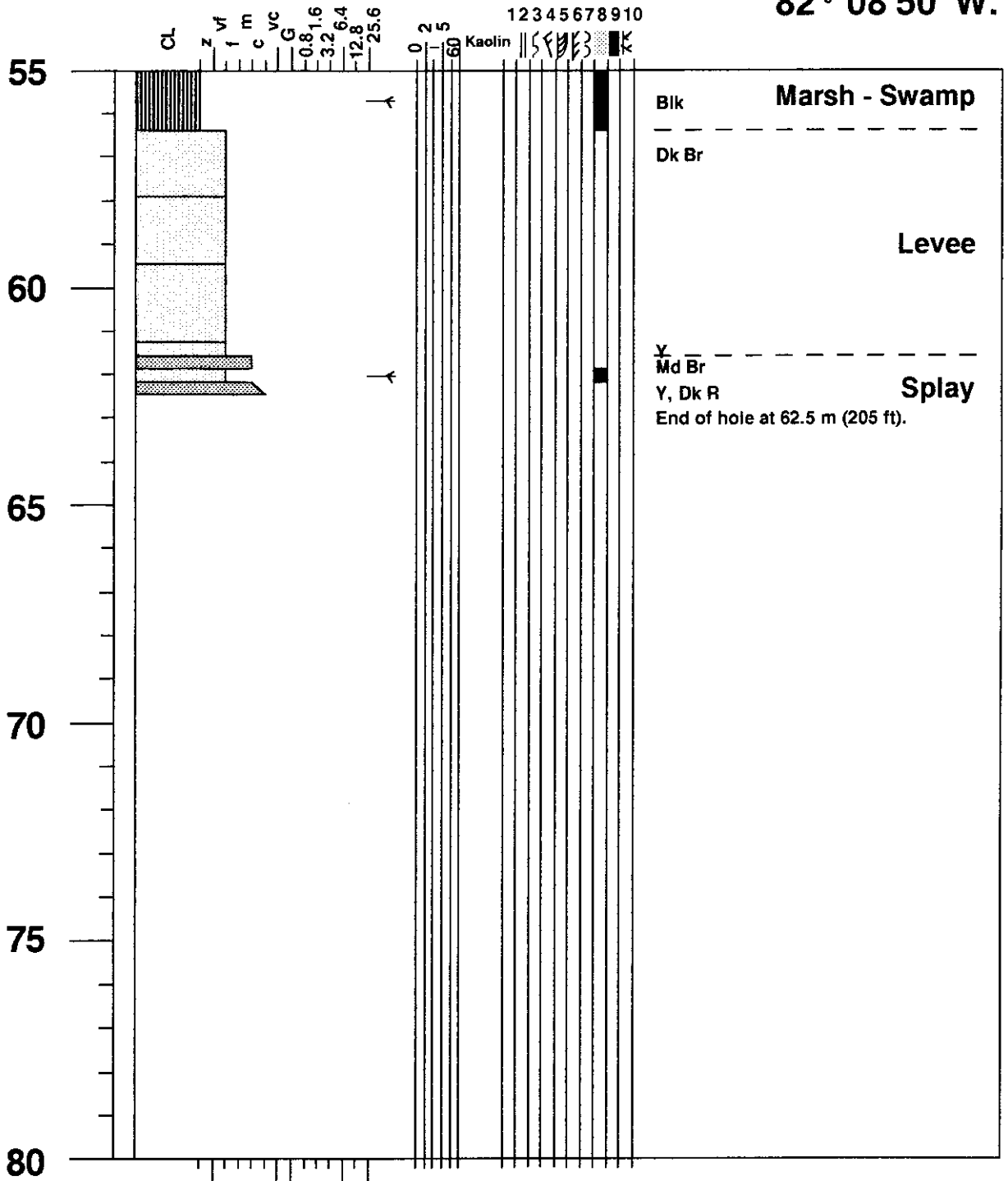
MRC hole 89 - 114, Kipling Twp.

50° 08'32"N,
82° 08'50"W.



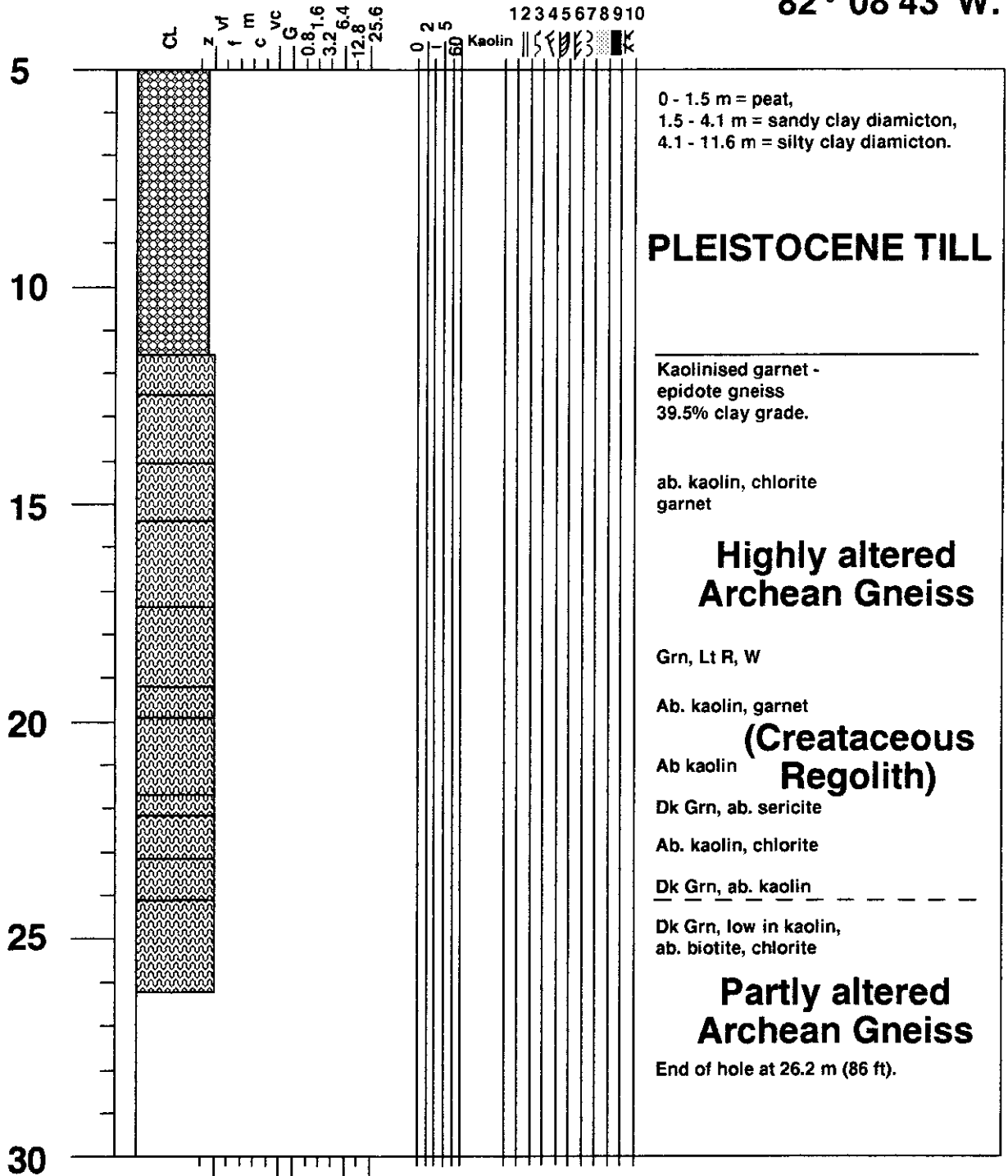
MRC hole 89 - 114, Kipling Twp.

50° 08'32"N,
82° 08'50"W.



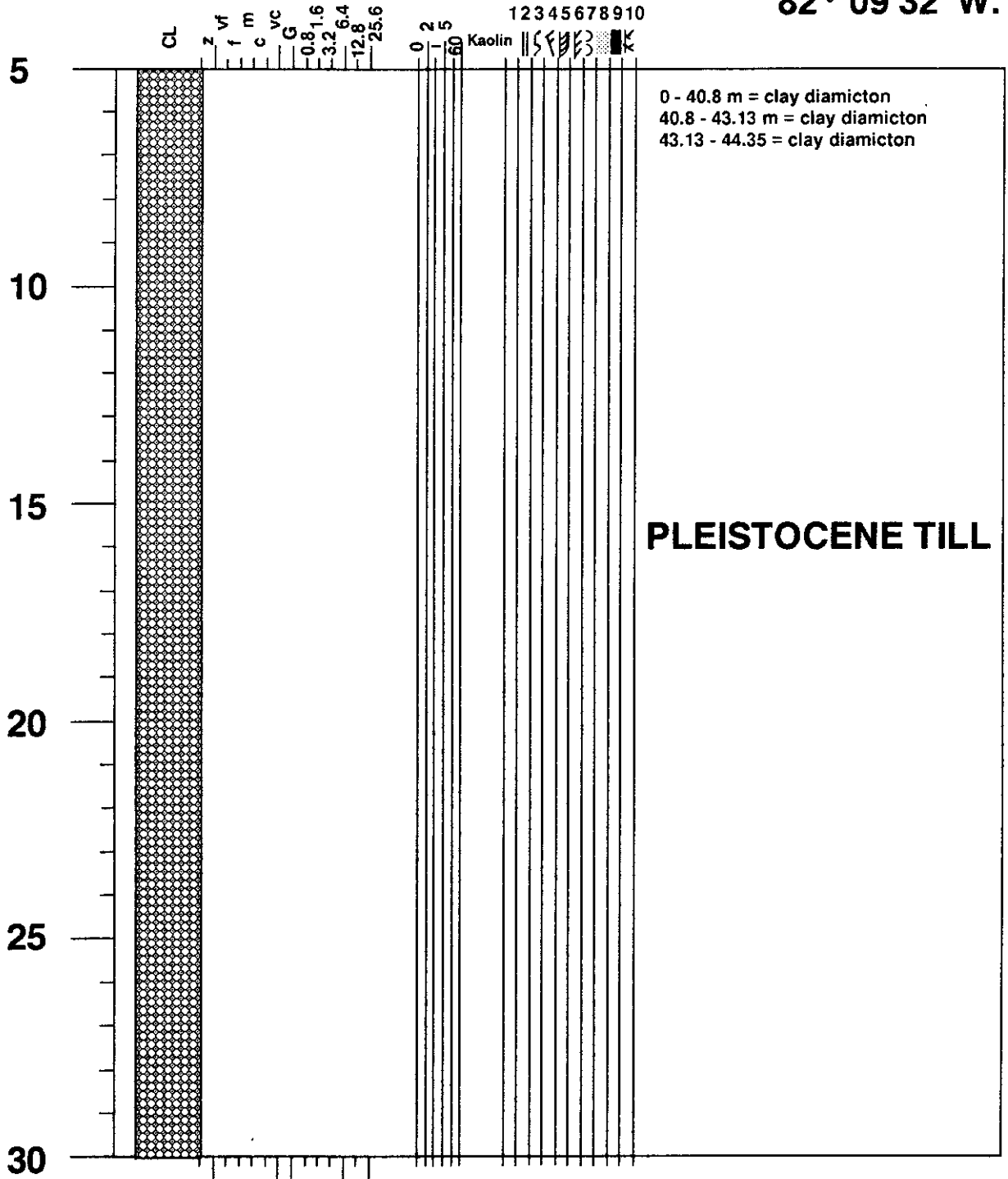
MRC hole 89 - 115, Kipling Twp.

50° 08'30"N,
82° 08'43"W.



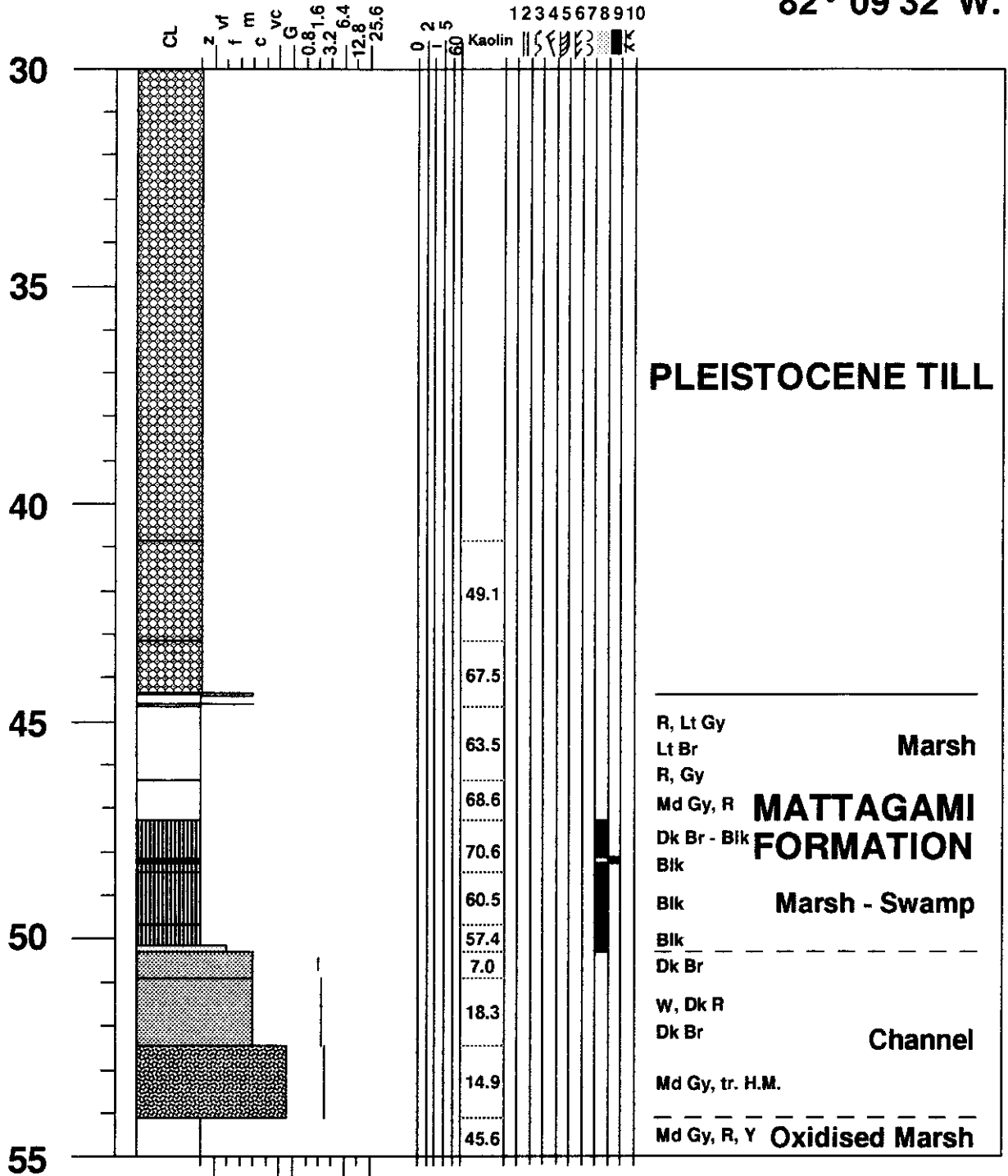
MRC hole 92- 3, Kipling Twp.

**50° 09'10"N,
82° 09'32"W.**



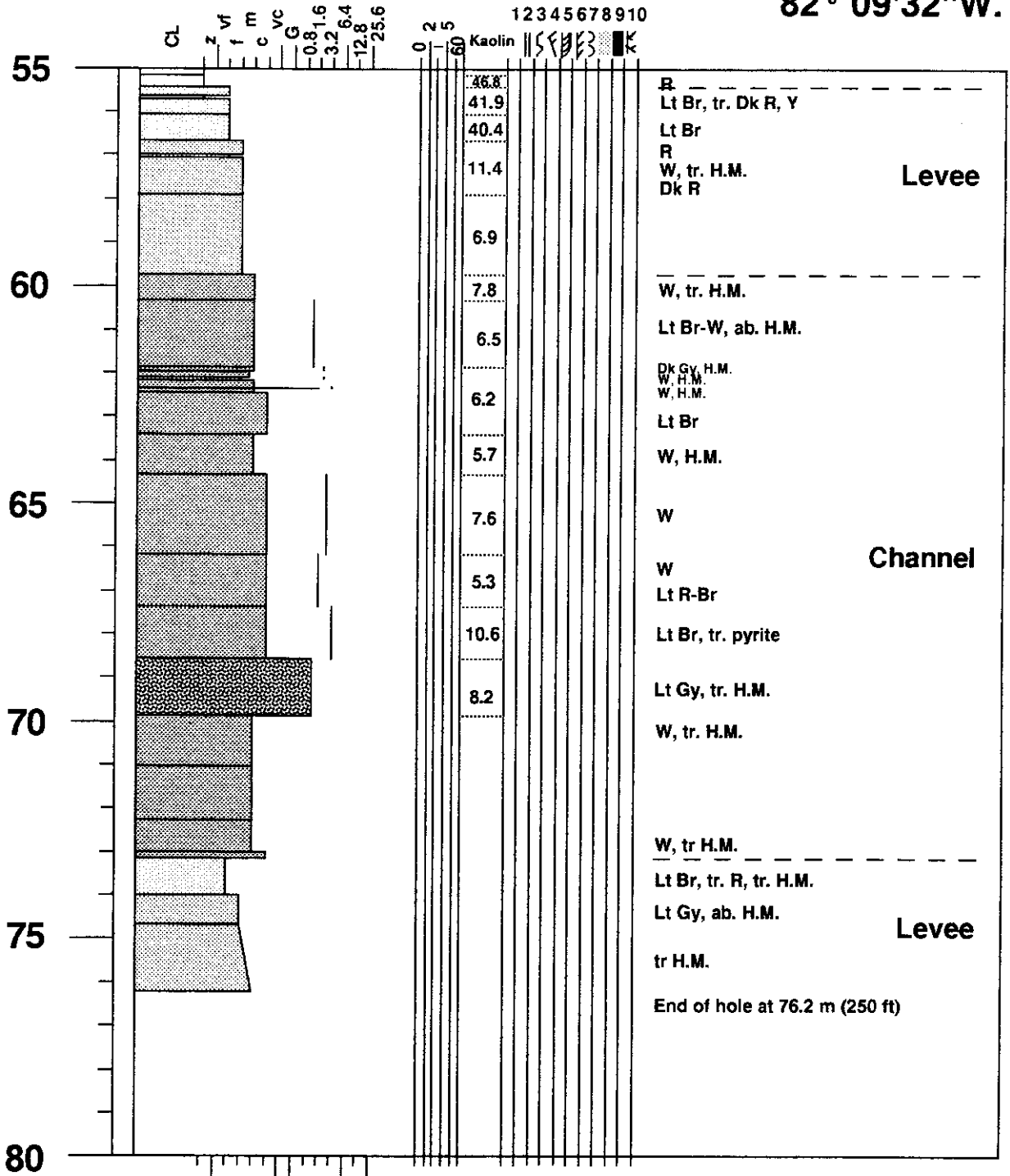
MRC hole 92- 3, Kipling Twp.

50° 09'10"N,
82° 09'32"W.



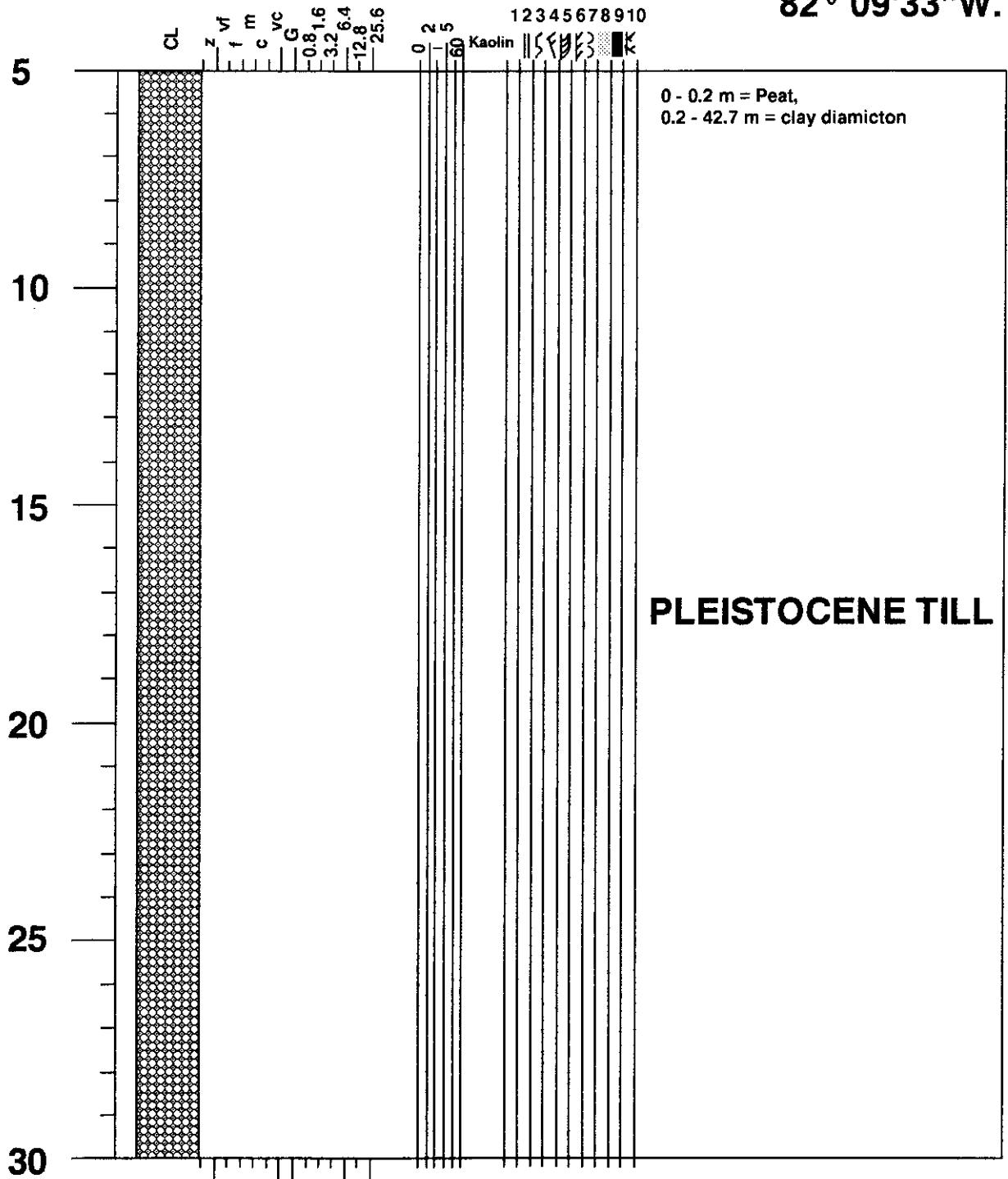
MRC hole 92- 3, Kipling Twp.

50° 09'10"N,
82° 09'32"W.



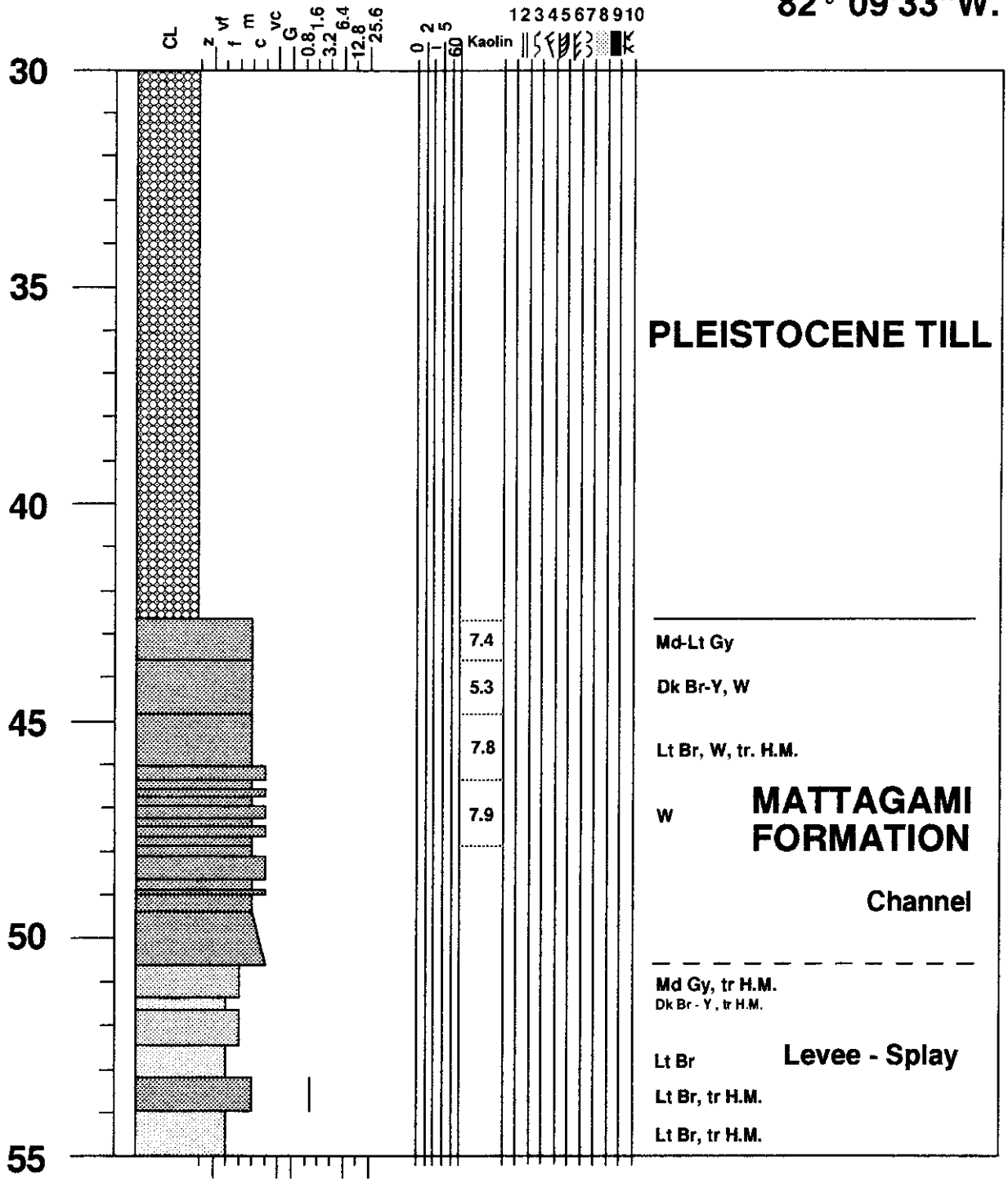
MRC hole 92-4, Kipling Twp.

50° 09'16"N,
82° 09'33"W.



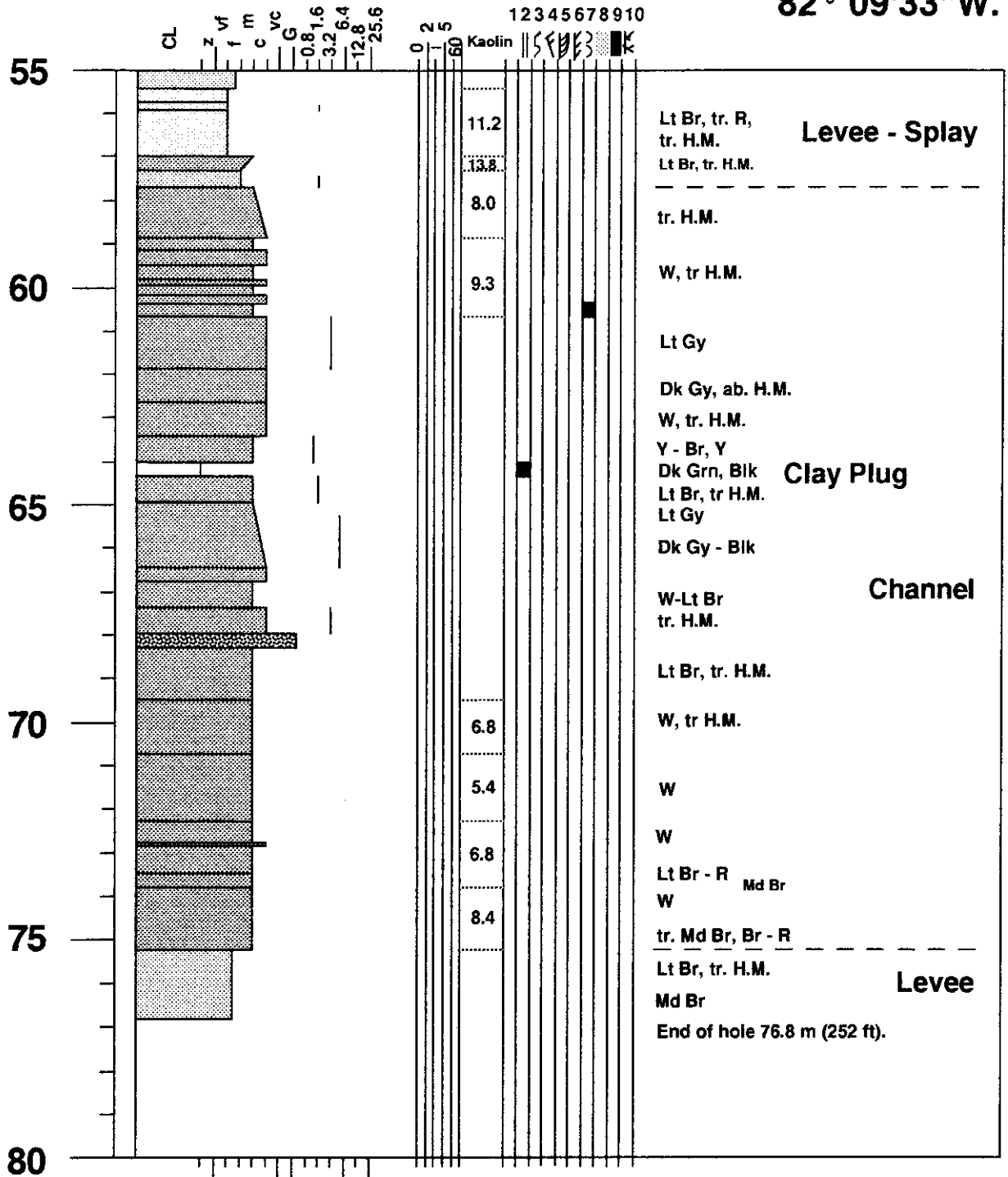
MRC hole 92-4, Kipling Twp.

50° 09'16"N,
82° 09'33"W.



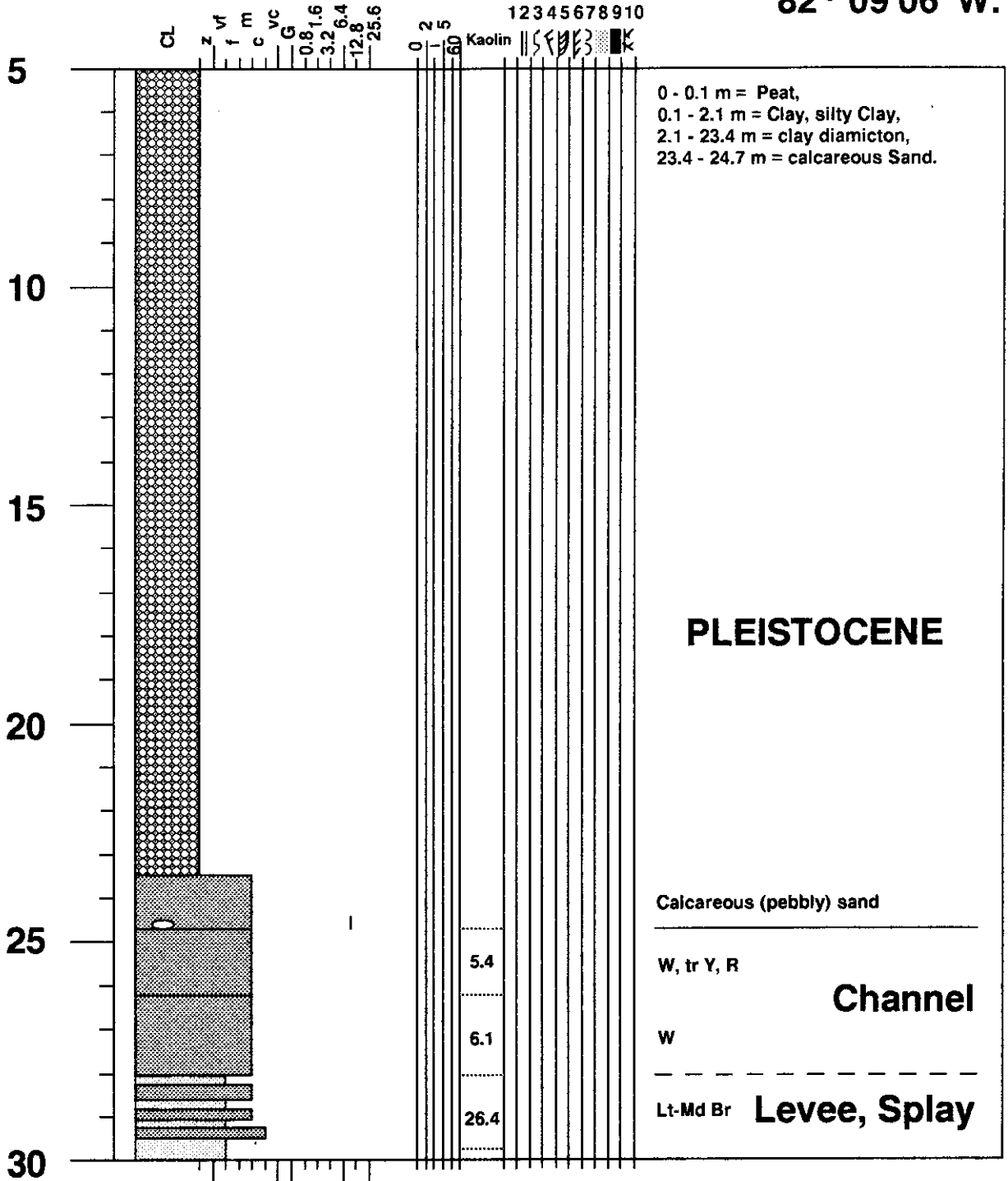
MRC hole 92-4, Kipling Twp.

50° 09'16"N,
82° 09'33"W.



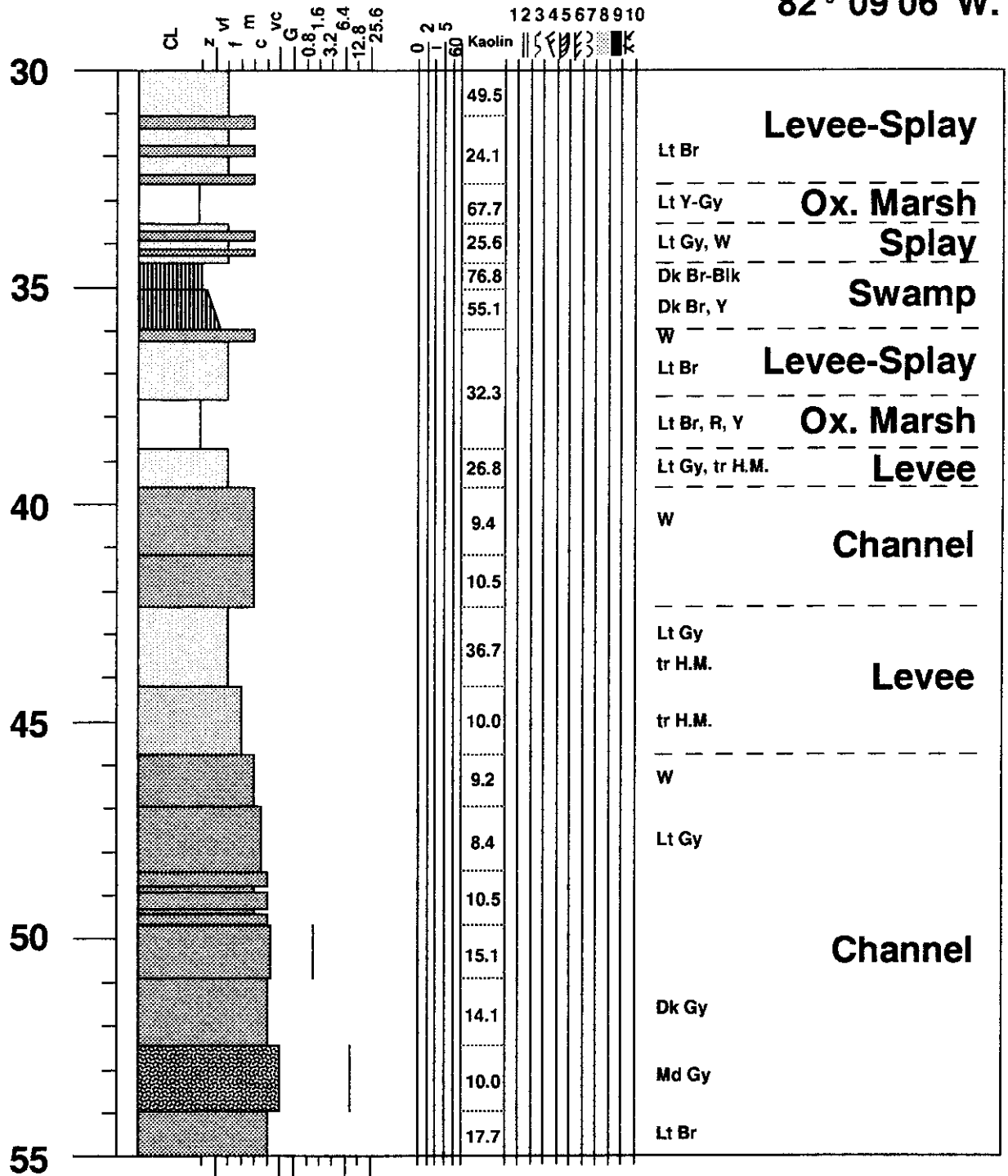
MRC hole 92 - 7, Kipling Twp.

50° 08'45"N,
82° 09'06"W.



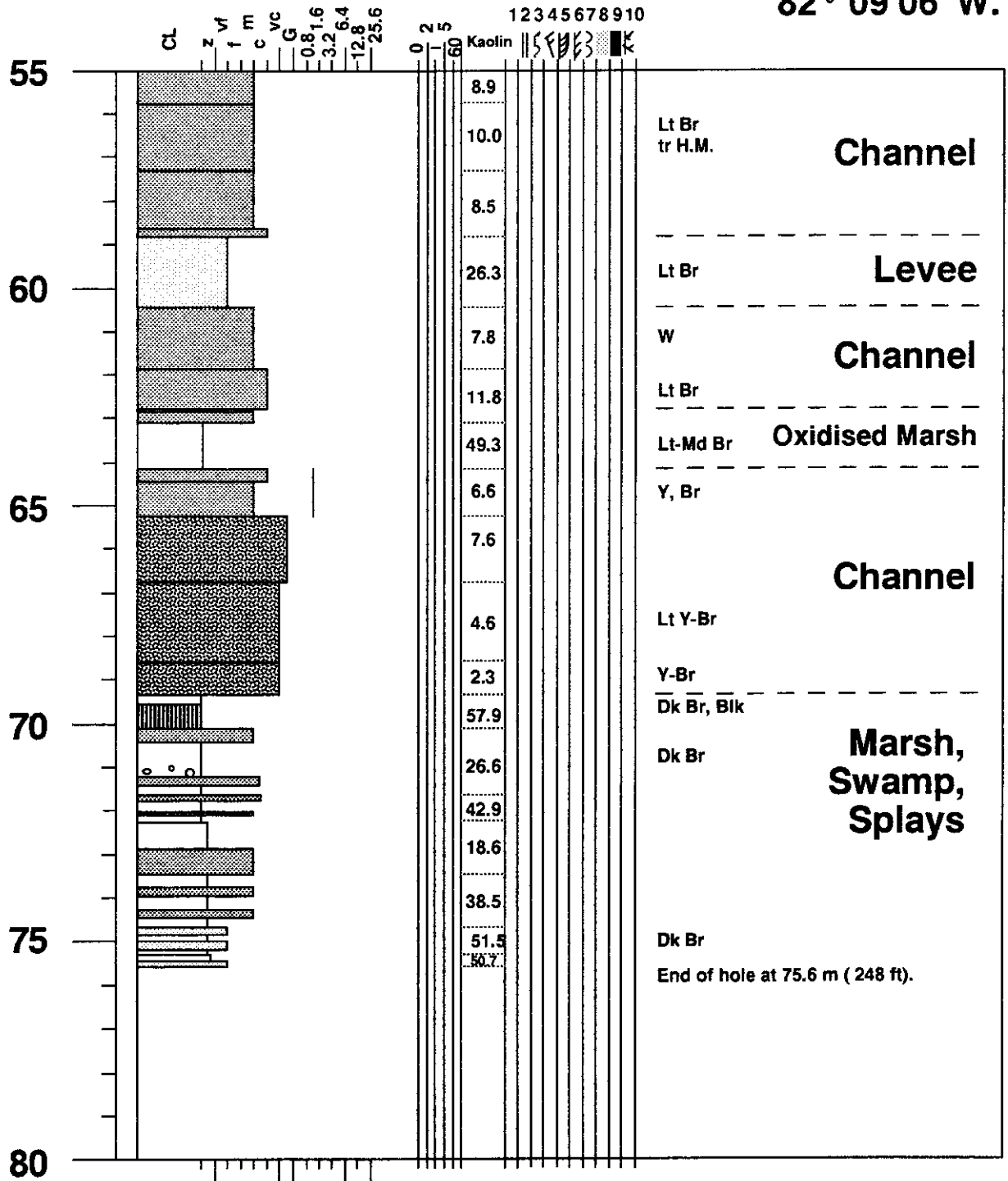
MRC hole 92 - 7, Kipling Twp.

50° 08'45"N,
82° 09'06"W.



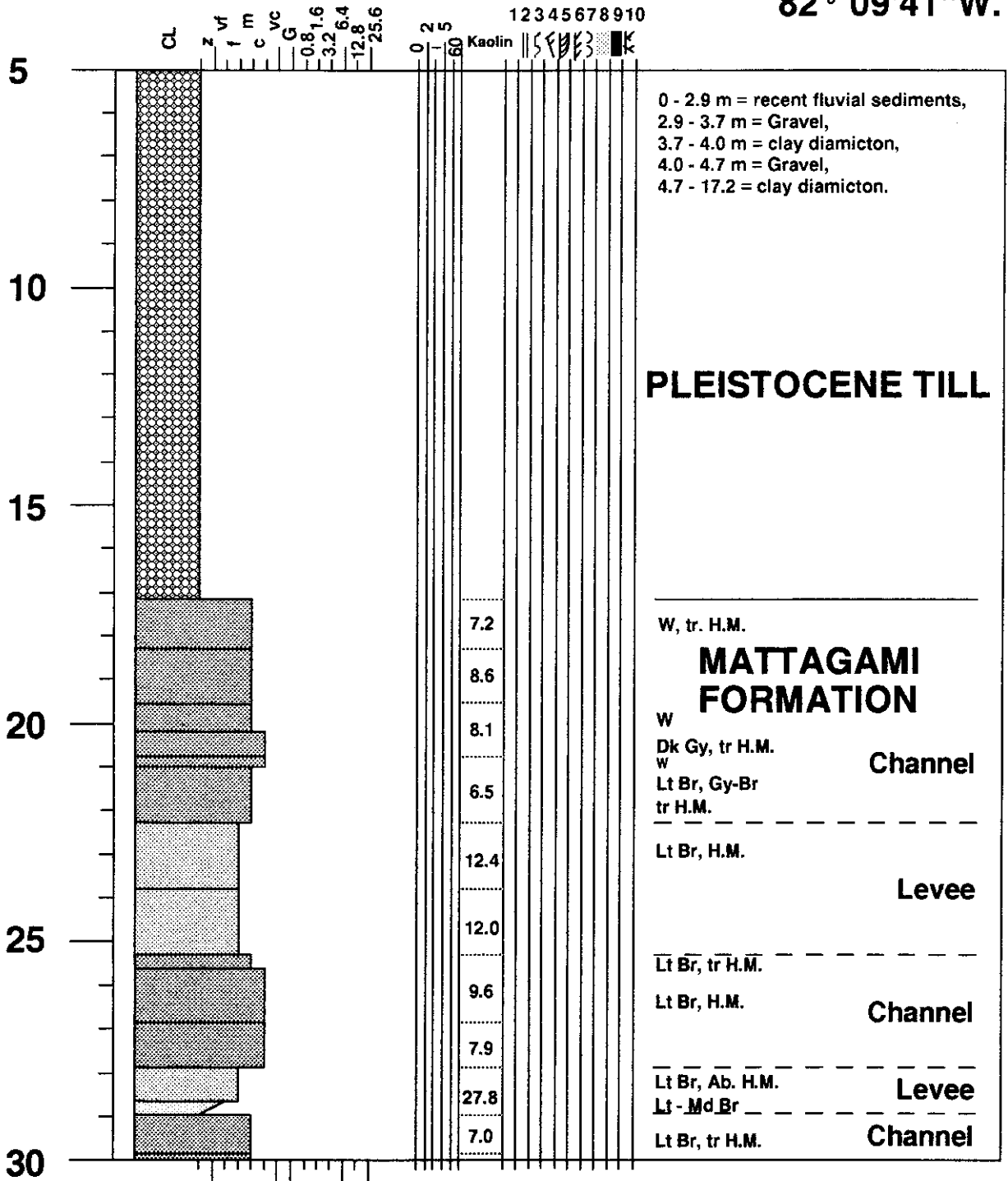
MRC hole 92 - 7, Kipling Twp.

50° 08'45"N,
82° 09'06"W.



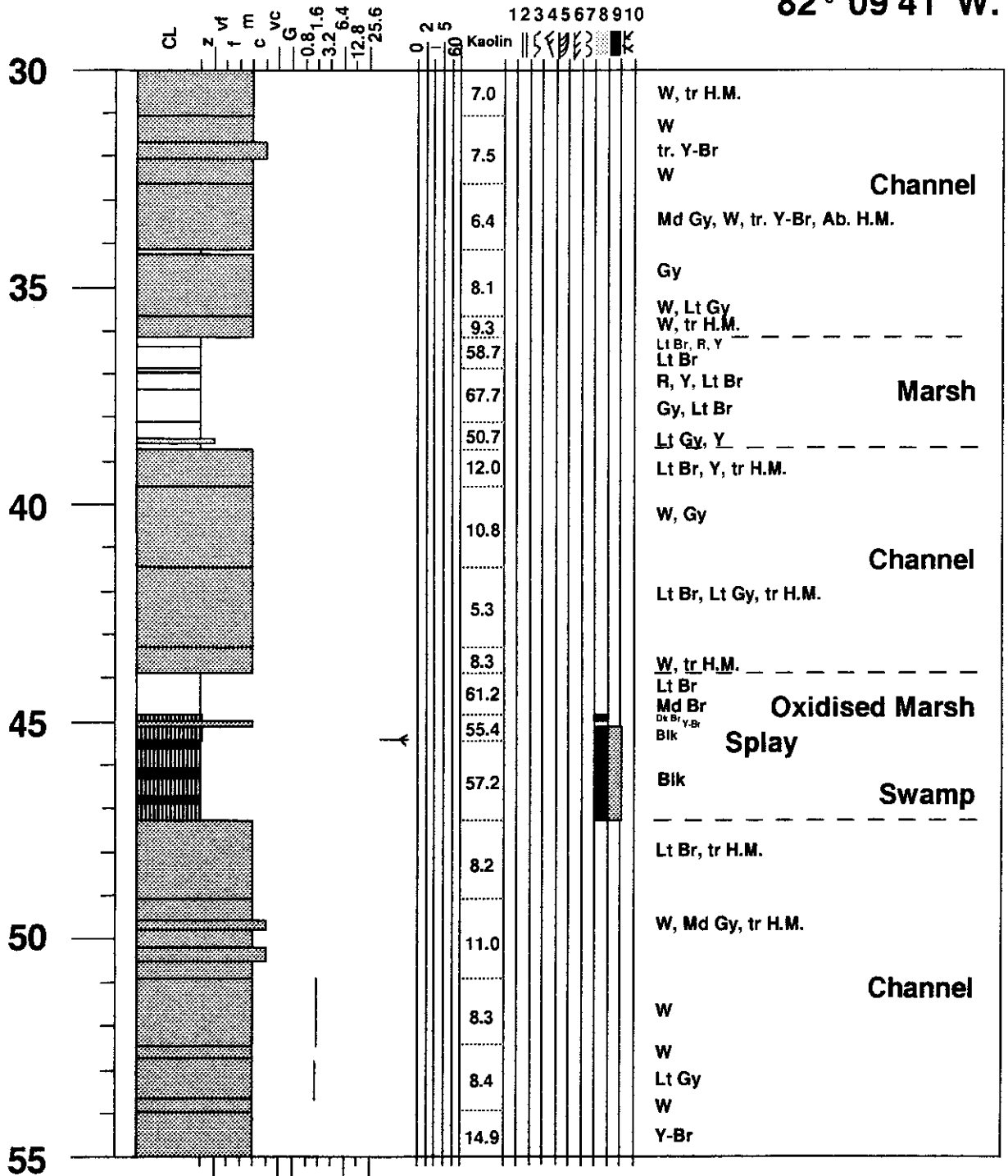
MRC hole 92 - 8, Kipling Twp.

50° 08'41"N,
82° 09'41"W.



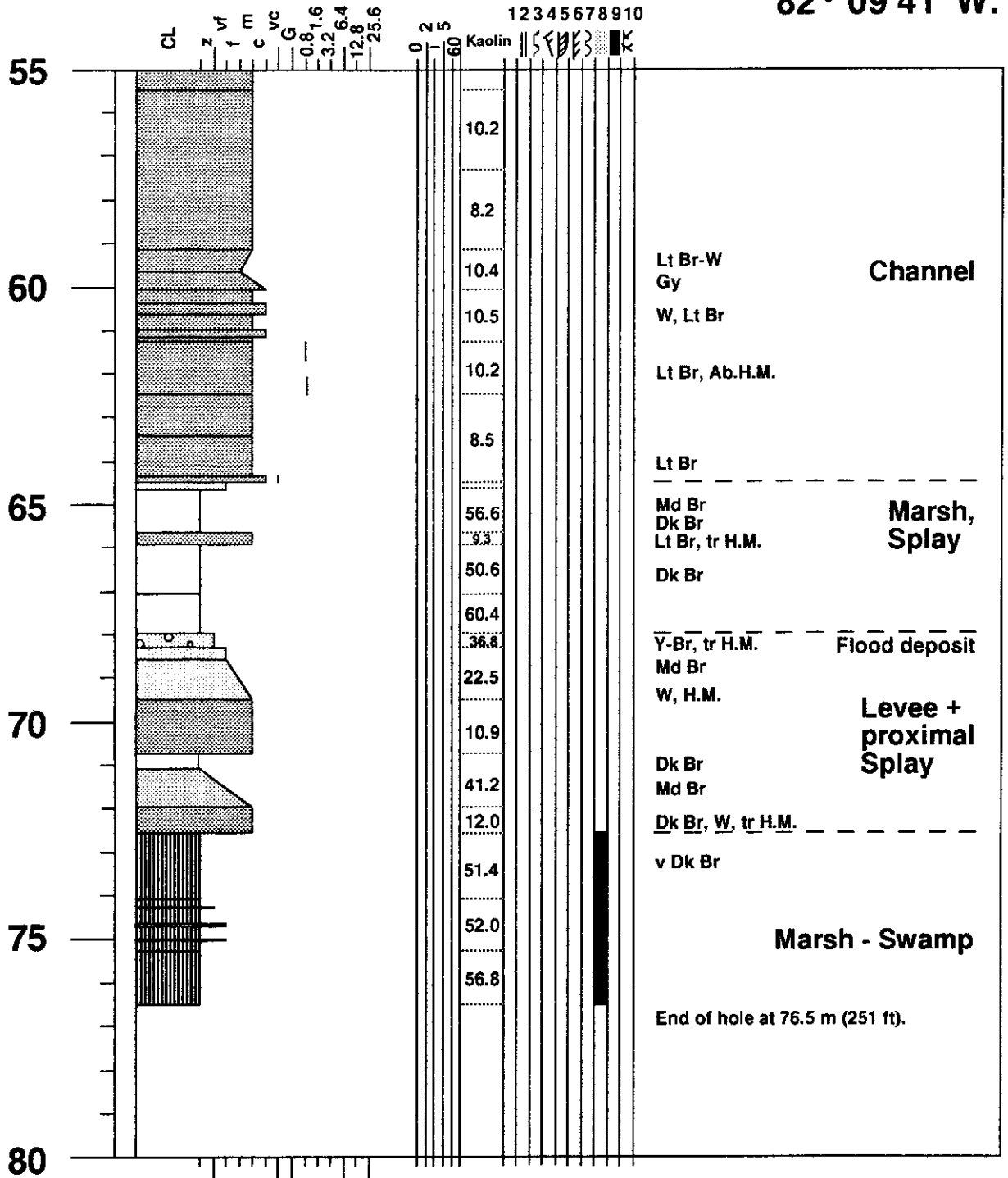
MRC hole 92 - 8, Kipling Twp.

50° 08'41"N,
82° 09'41"W.



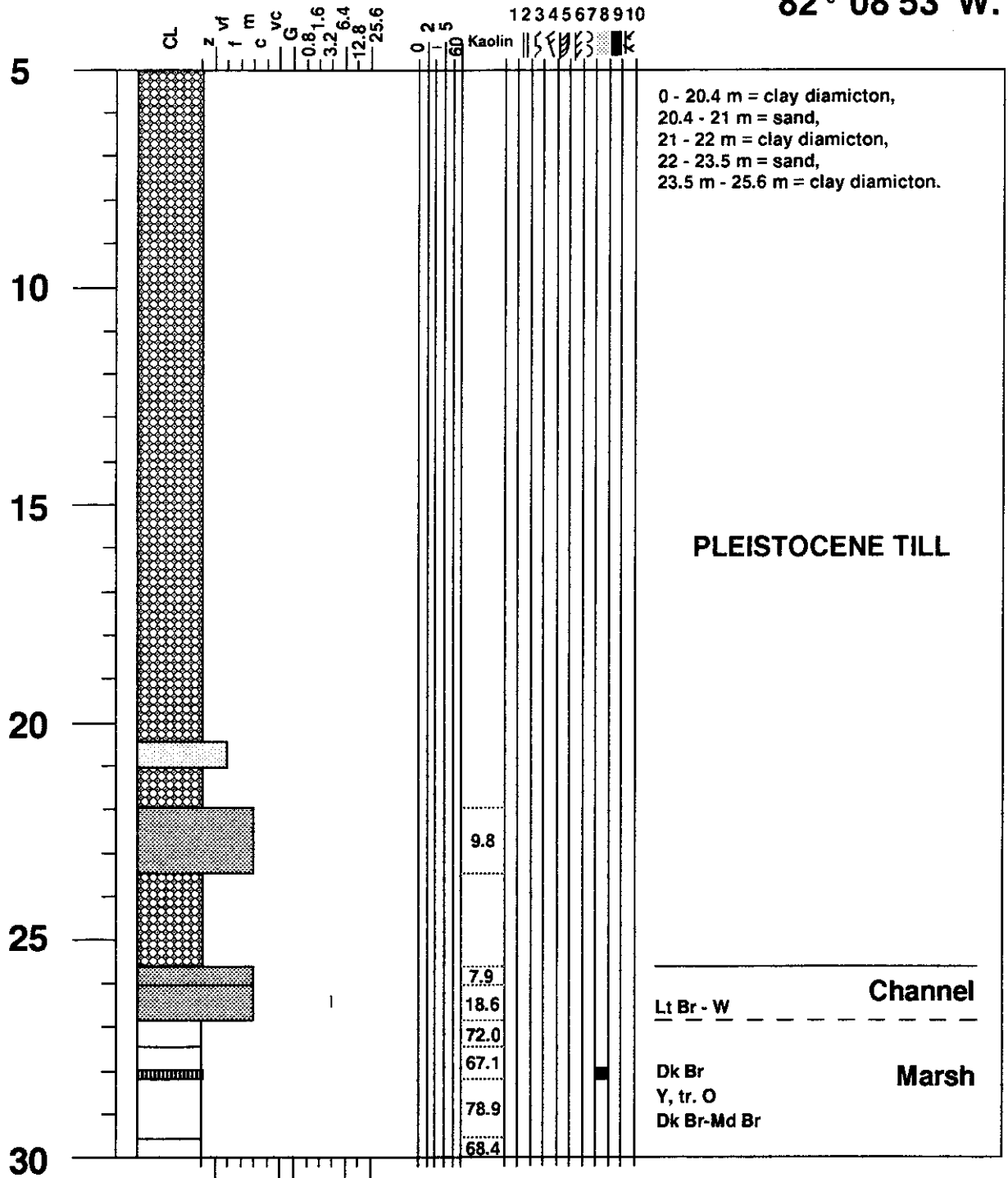
MRC hole 92 - 8, Kipling Twp.

50° 08'41"N,
82° 09'41"W.



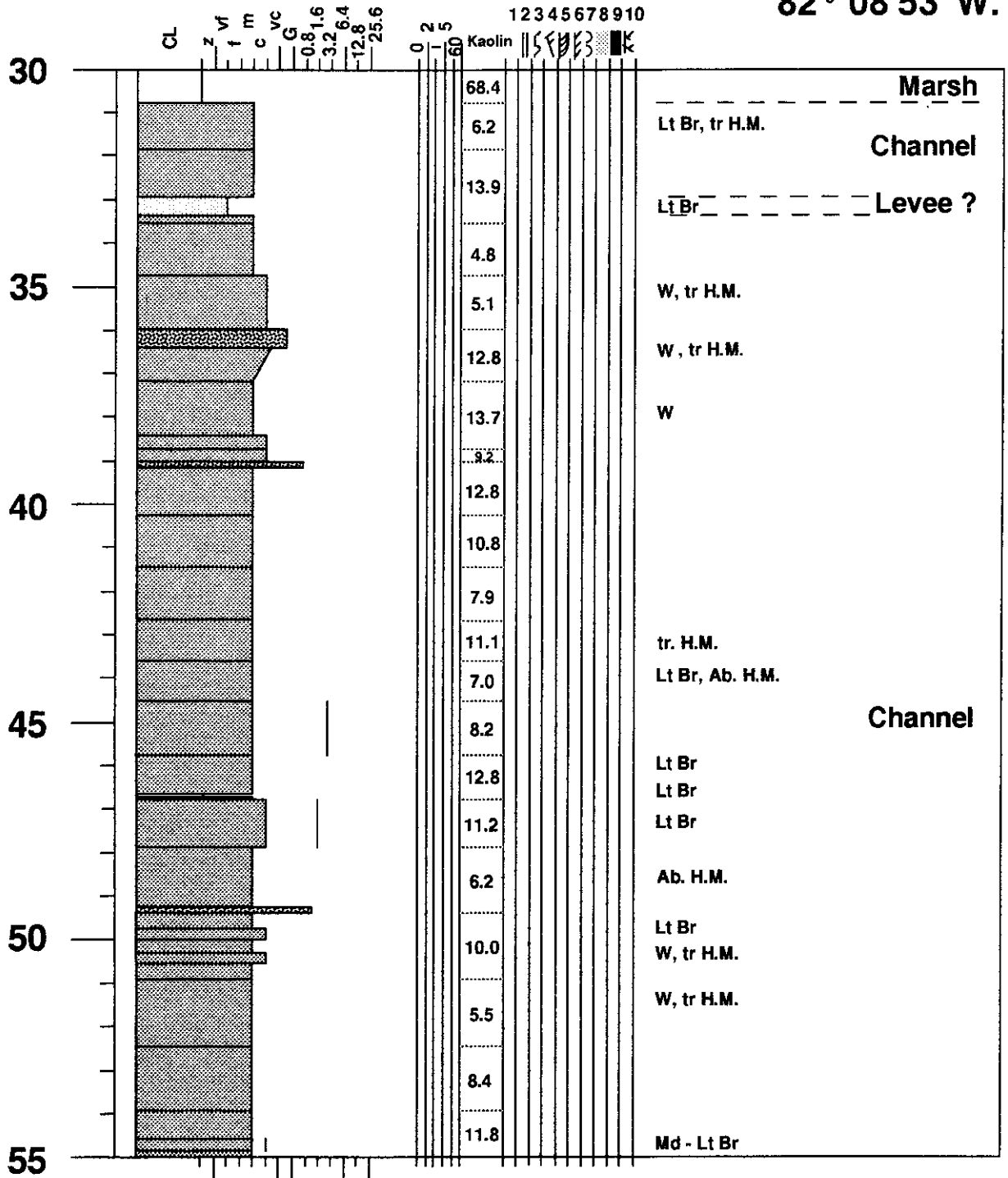
MRC hole 92-11, Kipling Twp.

50° 09'08"N,
82° 08'53"W.



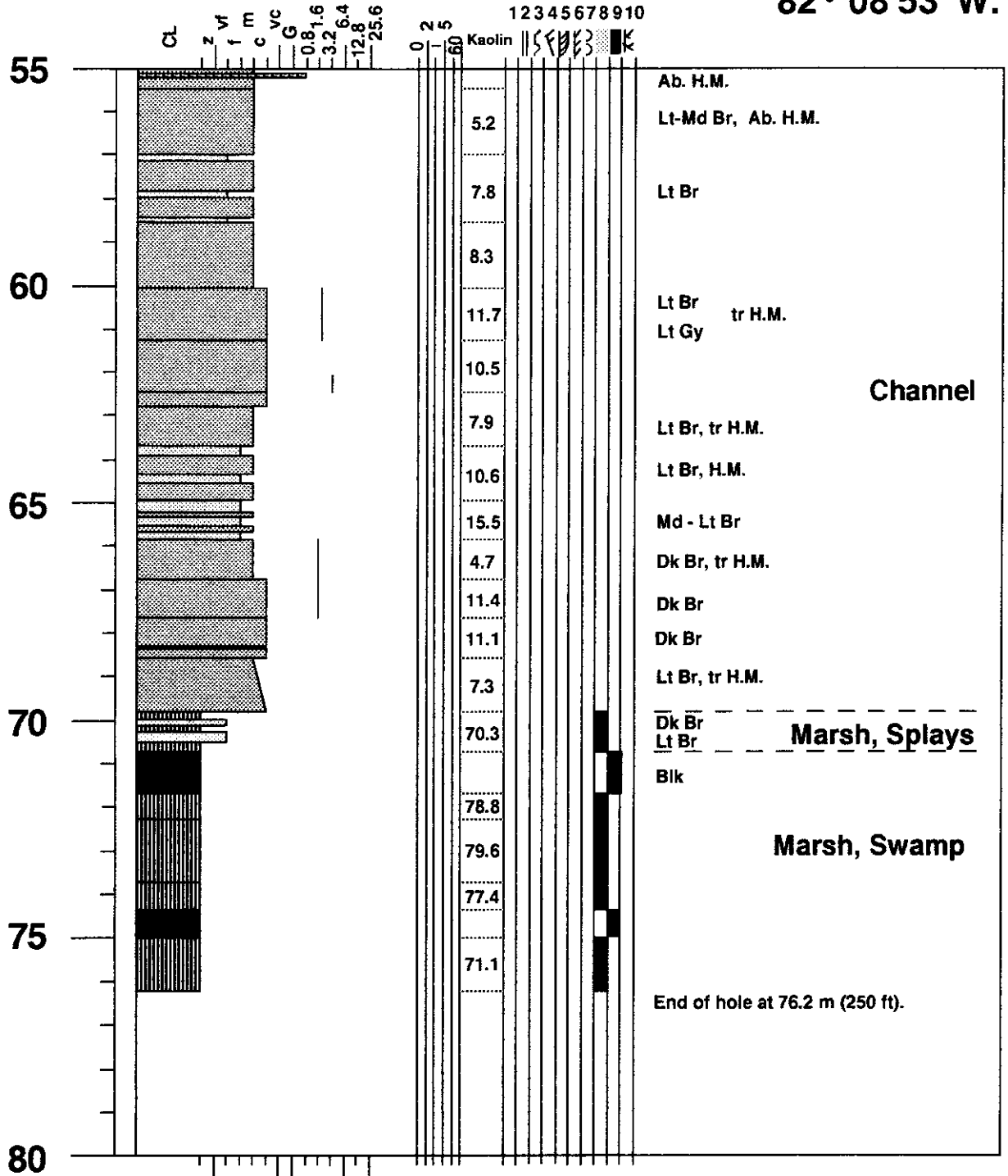
MRC hole 92-11, Kipling Twp.

50° 09'08"N,
82° 08'53"W.



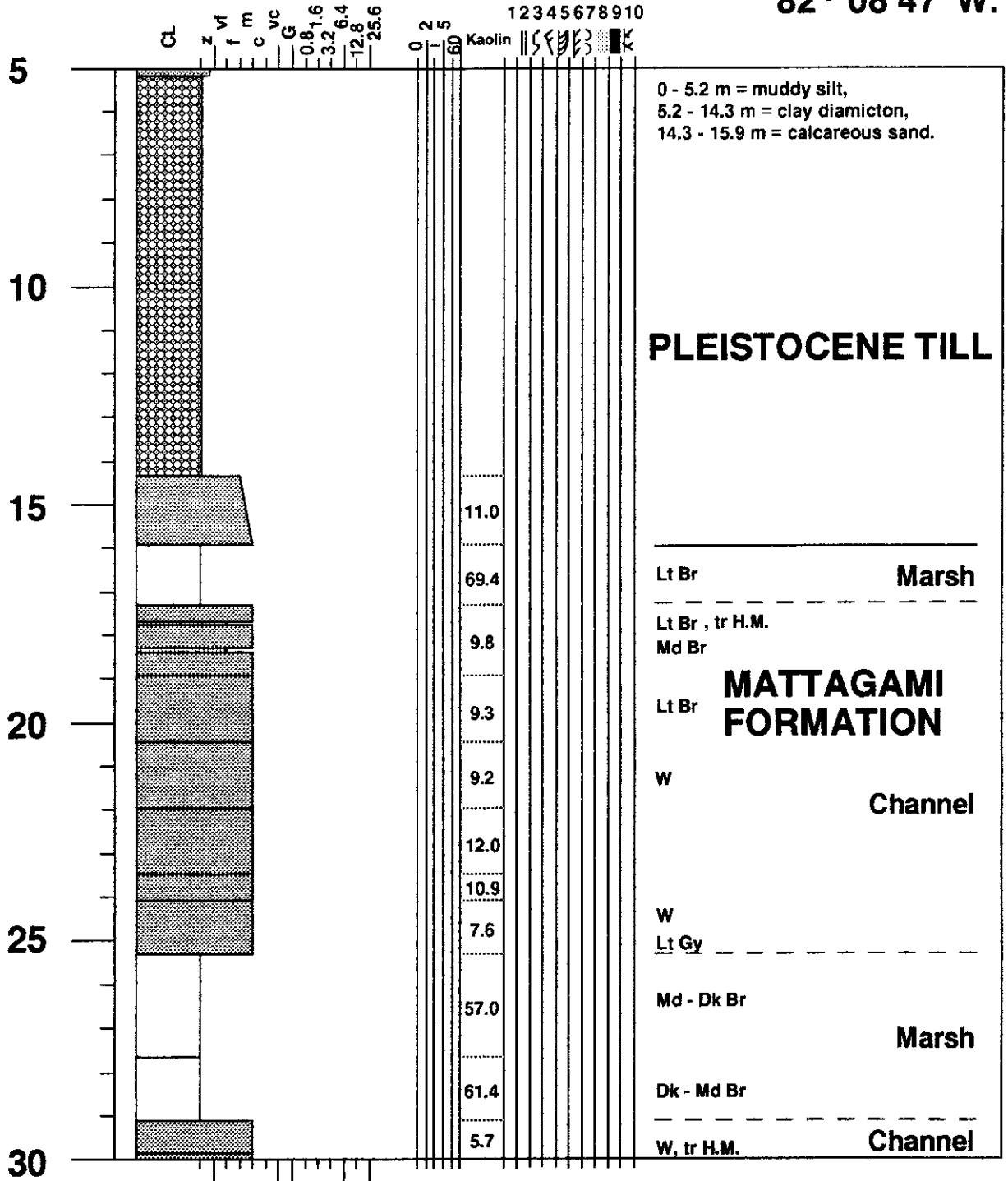
MRC hole 92-11, Kipling Twp.

50° 09'08"N,
82° 08'53"W.



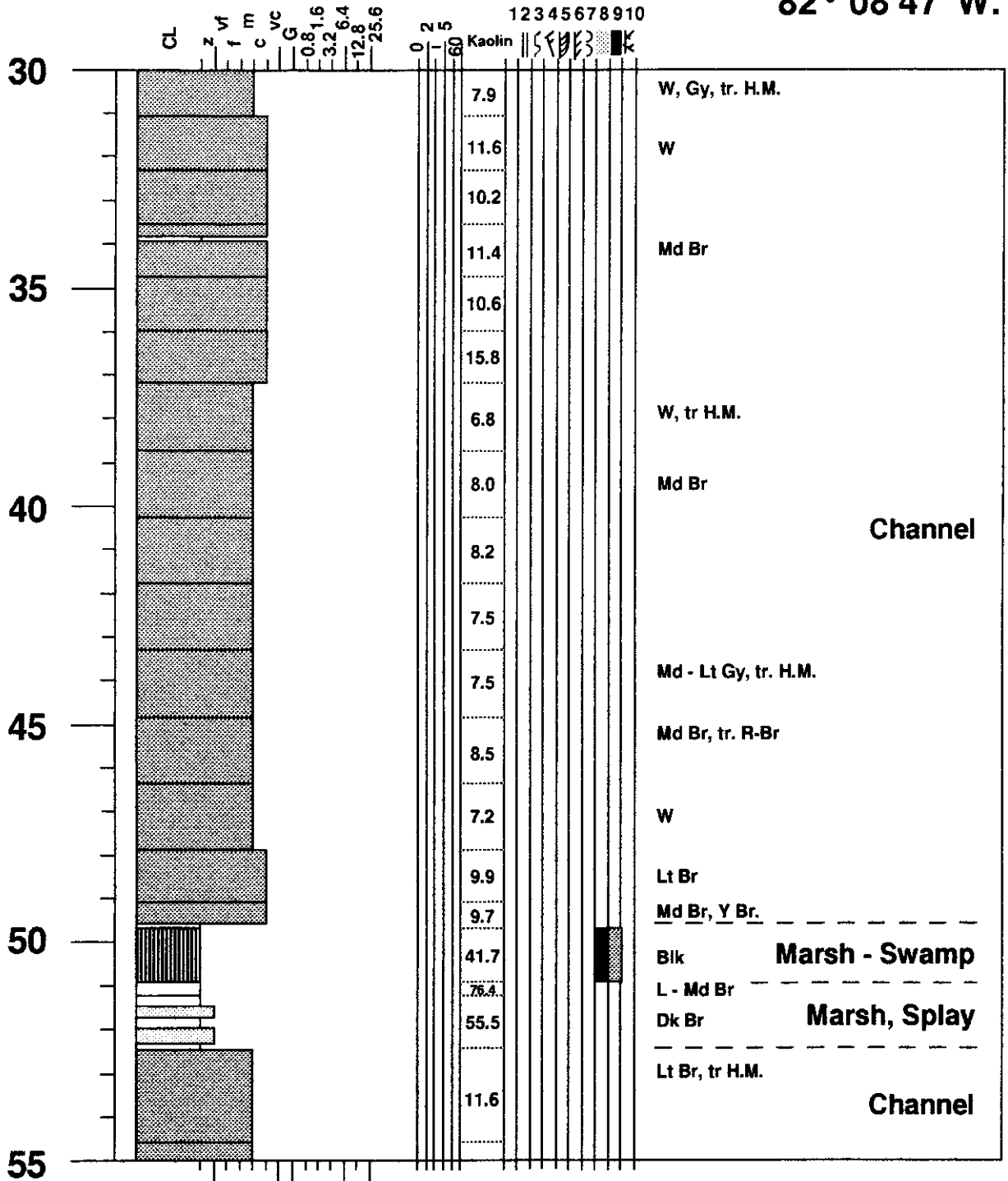
MRC hole 92-12, Kipling Twp.

50° 09'05"N,
82° 08'47"W.



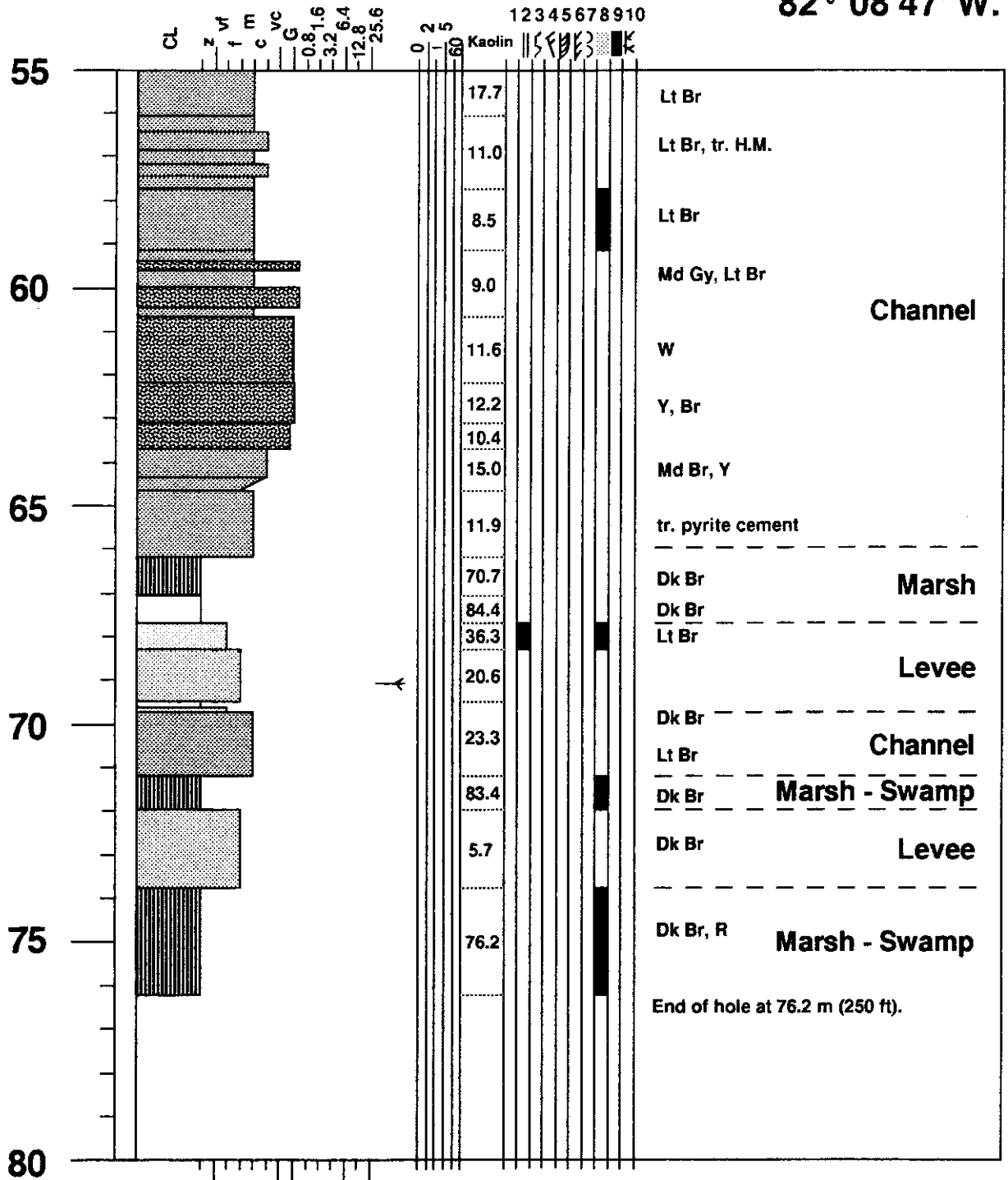
MRC hole 92-12, Kipling Twp.

50° 09'05"N,
82° 08'47"W.



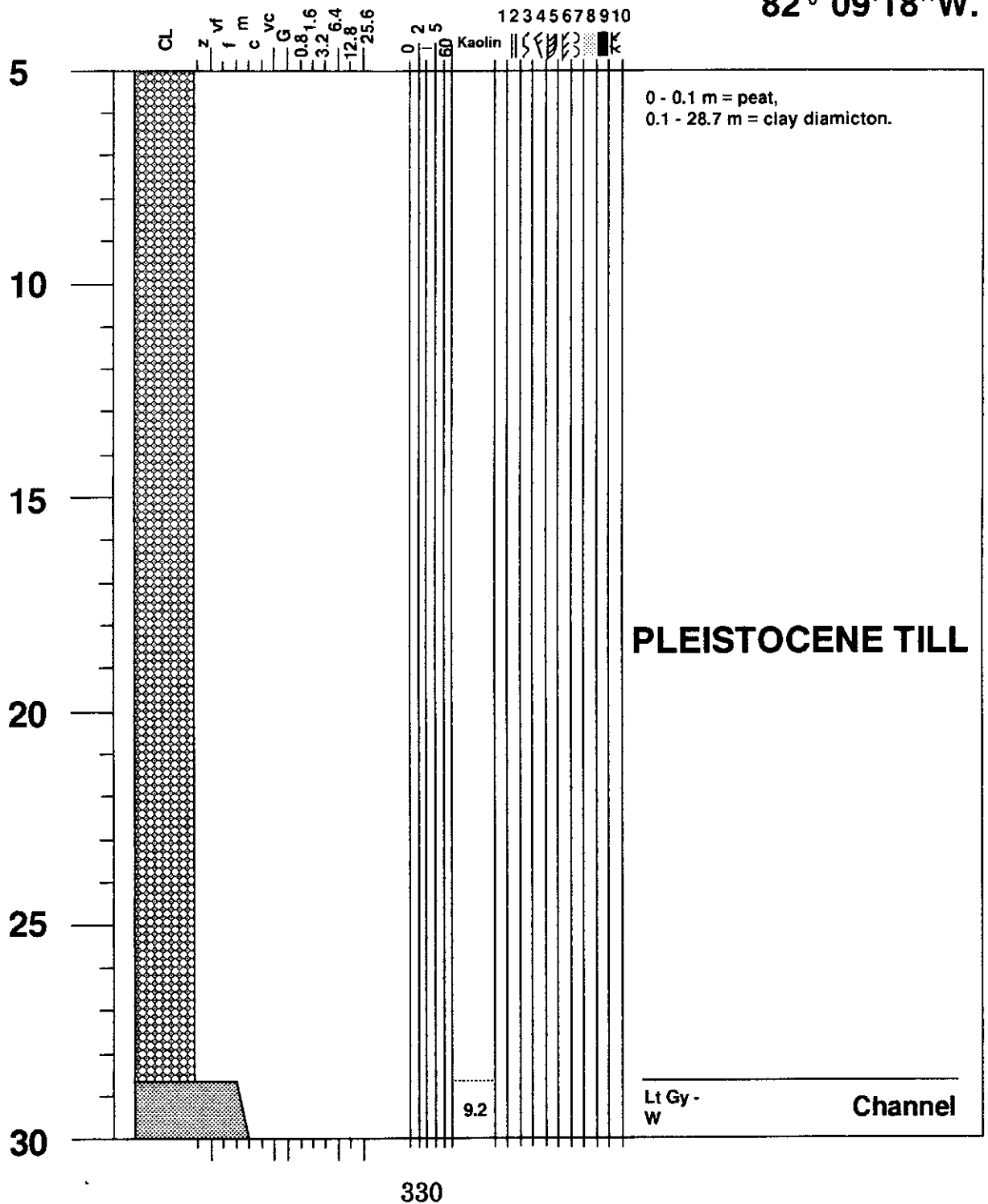
MRC hole 92-12, Kipling Twp.

50° 09'05"N,
82° 08'47"W.



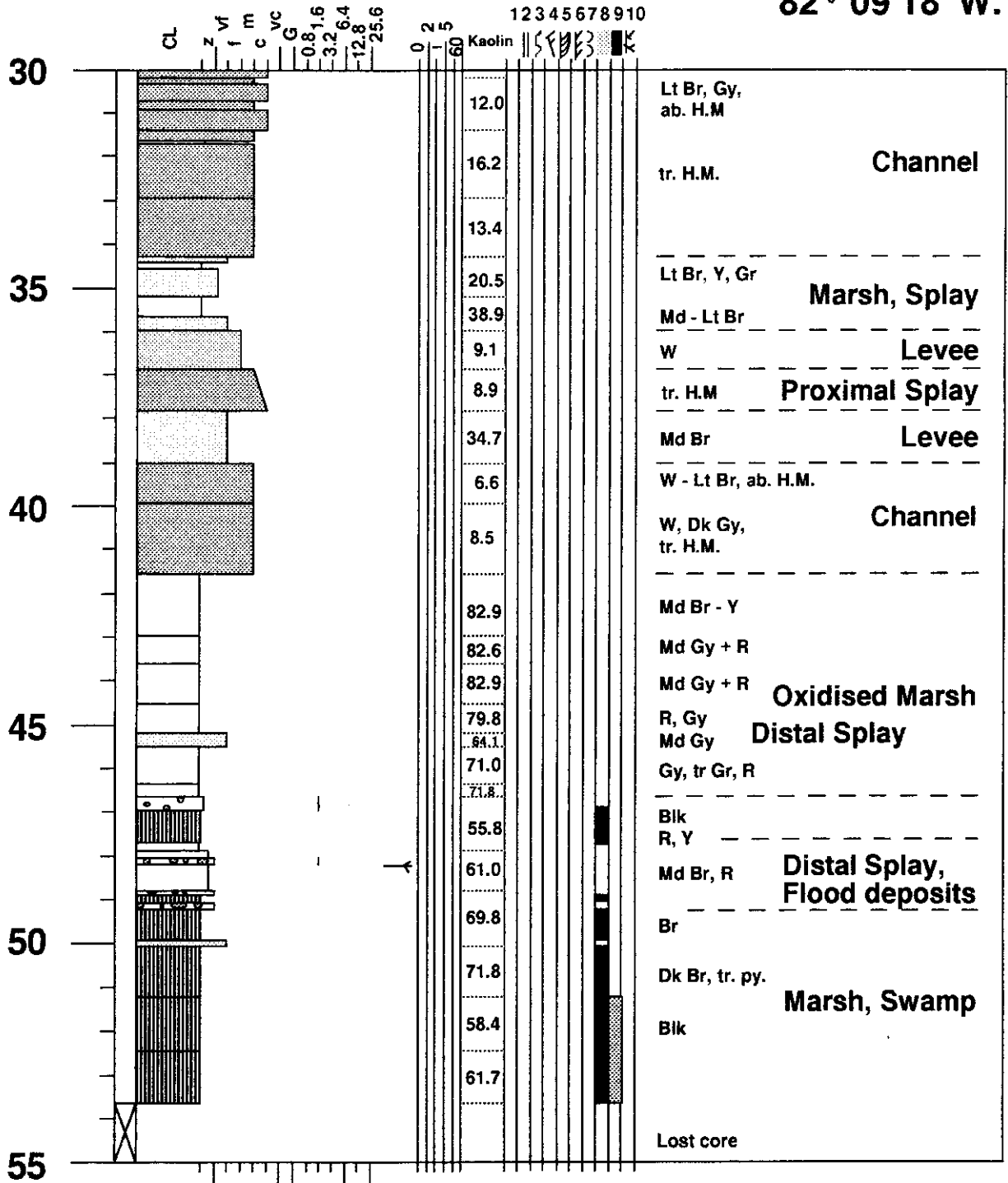
MRC hole 92 - 29, Kipling Twp.

50° 08'52"N,
82° 09'18"W.



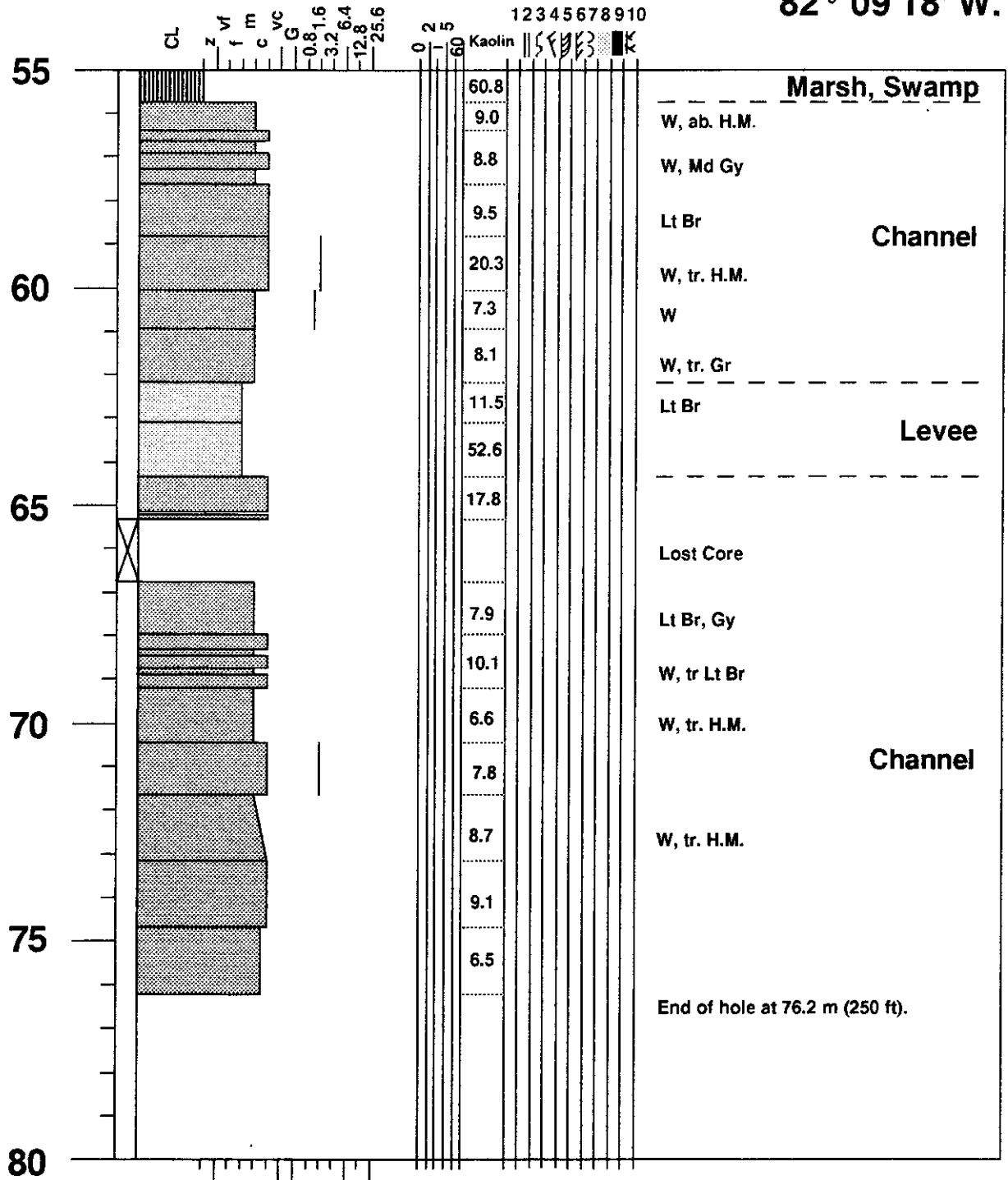
MRC hole 92 - 29, Kipling Twp.

50° 08'52"N,
82° 09'18"W.



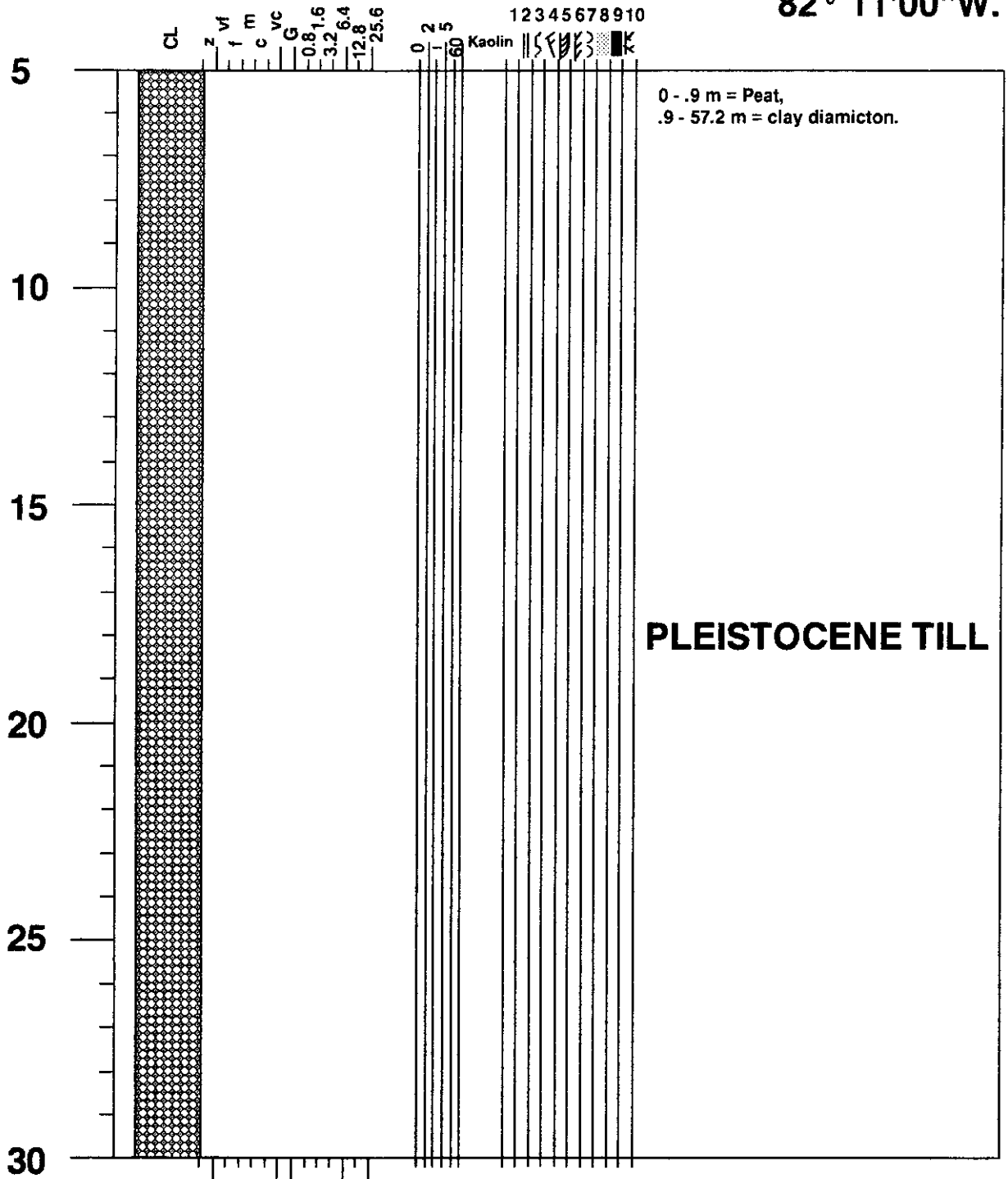
MRC hole 92 - 29, Kipling Twp.

50° 08'52"N,
82° 09'18"W.



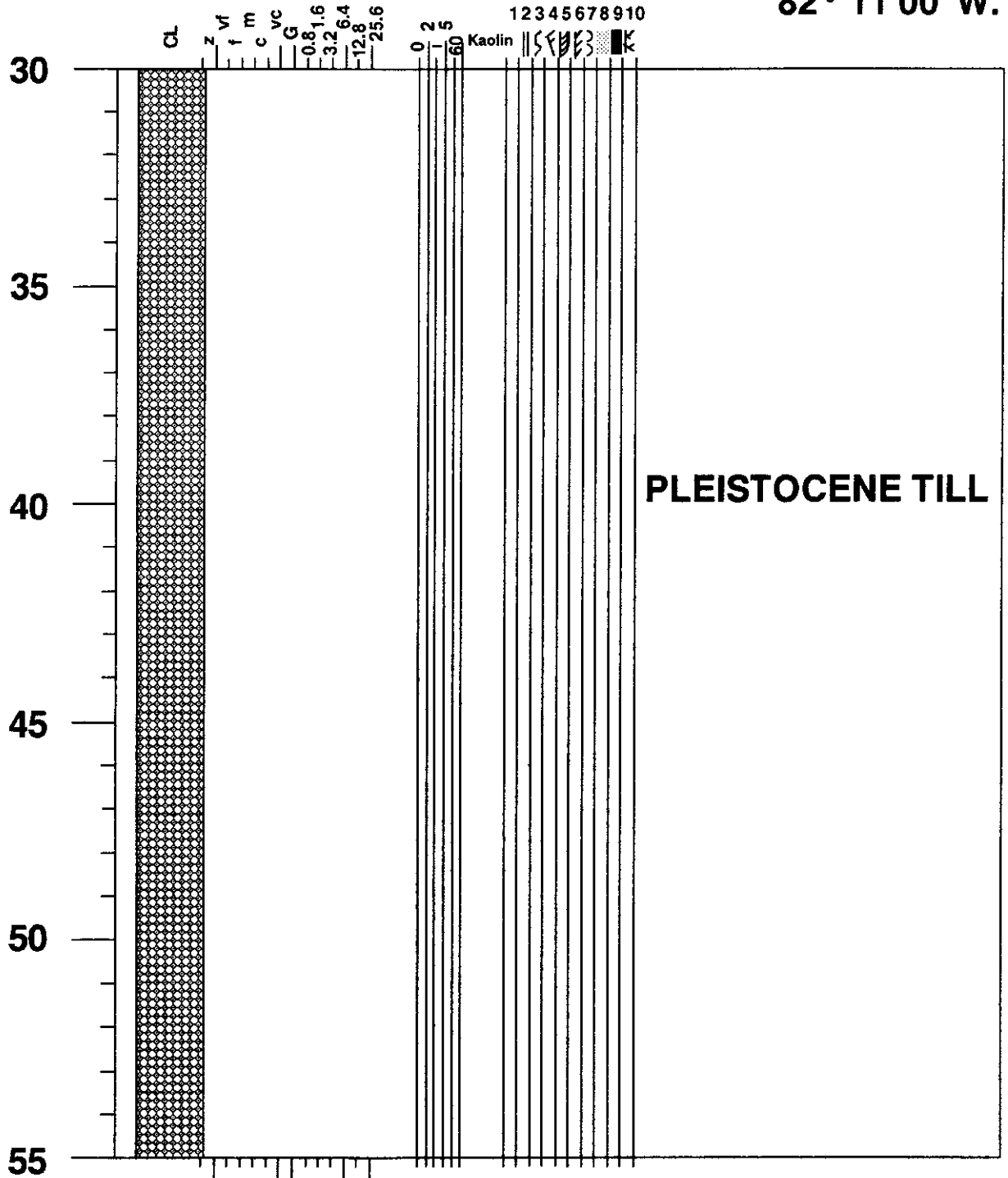
MRC hole 92-30, Kipling Twp.

50° 08'56"N,
82° 11'00"W.



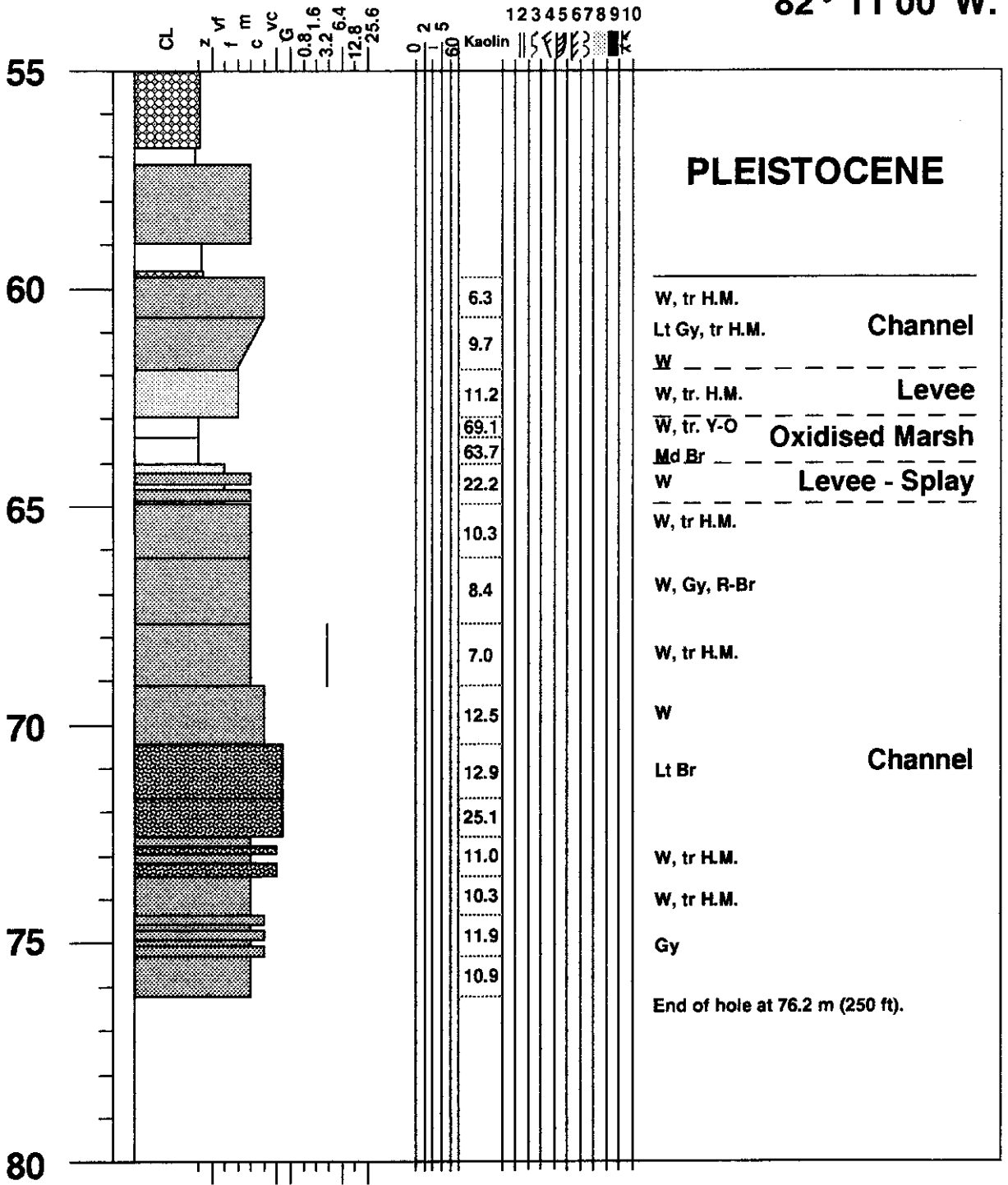
MRC hole 92-30, Kipling Twp.

50° 08'56"N,
82° 11'00"W.



MRC hole 92-30, Kipling Twp.

50° 08'56"N,
82° 11'00"W.



**CONVERSION FACTORS FOR MEASUREMENTS IN ONTARIO
GEOLOGICAL SURVEY PUBLICATIONS**

Conversion from SI to Imperial			Conversion from Imperial to SI		
<i>SI Unit</i>	<i>Multiplied by</i>	<i>Gives</i>	<i>Imperial Unit</i>	<i>Multiplied by</i>	<i>Gives</i>
LENGTH					
1 mm	0.039 37	inches	1 inch	25.4	mm
1 cm	0.393 70	inches	1 inch	2.54	cm
1 m	3.280 84	feet	1 foot	0.304 8	m
1 m	0.049 709 7	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	1.609 344	km
AREA					
1 cm@	0.155 0	square inches	1 square inch	6.451 6	cm@
1 m@	10.763 9	square feet	1 square foot	0.092 903 04	m@
1 km@	0.386 10	square miles	1 square mile	2.589 988	km@
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
VOLUME					
1 cm#	0.061 02	cubic inches	1 cubic inch	16.387 064	cm#
1 m#	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m#
1 m#	1.308 0	cubic yards	1 cubic yard	0.764 555	m#
CAPACITY					
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	4.546 090	L
MASS					
1 g	0.035 273 96	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 75	ounces (troy)	1 ounce (troy)	31.103 476 8	g
1 kg	2.204 62	pounds (avdp)	1 pound (avdp)	0.453 592 37	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	907.184 74	kg
1 t	1.102 311	tons (short)	1 ton (short)	0.907 184 74	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	1016.046 908 8	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	1.016 046 908 8	t
CONCENTRATION					
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

	<i>Multiplied by</i>	
1 ounce (troy) per ton (short)	20.0	pennyweights per ton (short)
1 pennyweight per ton (short)	0.05	ounces (troy) per ton (short)

Note: Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries, published by the Mining Association of Canada in co-operation with the Coal Association of Canada.

3268
ISSN 0826-9580
ISBN 0-7778-3771-4