U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Sedimentological descriptions and geophysical logs of two 300-m cores collected from the Straight Cliffs Formation of the Kaiparowits Plateau, Kane County, Utah

by

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ILLUSTRATIONS

INTRODUCTION

In 1991, the U.S. Geological Survey (USGS) retrieved continuous core from two 300-m drill holes (CT-1-91 and SMP-1-91) drilled in Upper Cretaceous strata of the Kaiparowits Plateau, Utah (fig. 1). The core was collected to provide insight into the eustatic, tectonic, and climatic controls on coal accumulation and quality. Ongoing studies of the core include: 1) geochemical coal analyses (USGS, Branch of Coal Geology); 2) coal facies analyses (Brenda Pierce, USGS, Branch of Coal Geology); 3) palynomorph identifications (Doug Nichols, USGS, Branch of Paleontology and Stratigraphy); and 4) petrographic examinations (John Breyer, Texas Christian University, Fort Worth, Tex.). Preliminary results from coal and clastic facies analyses have been published in abstracts by Pierce et al. (1992), and Hettinger and McCabe (1992a, 1992b). This report presents the geophysical logs, facies descriptions, and preliminary depositional interpretations from cores CT-1-91 and SMP-1-91.

The drill holes are located in the interior regions of the Kaiparowits Plateau, in the Collet Top and Ship Mountain Point 7.5' topographic quadrangles (figs. 2, 3). CT-1-91 is located on the southwest limb of the Rees Canyon anticline and the underlying strata dip less than 1^0 to the southwest (Zeller, 1978). SMP-1-91 is located on the east limb of the Last Chance syncline and the underlying strata dip 3^0 to the southwest (Zeller and Vaninetti, 1990). No faults were mapped in the vicinity of either drill site. Both holes were initiated near the top of the Straight Cliffs Formation, as mapped by Zeller (1978) and Zeller and Vaninetti (1990). Core was retrieved from Turonian through Campanian strata of the Tibbet (upper part), Calico, A-sandstone, and Drip Tank (lower part) sequences (fig. 4) as defined by Shanley and McCabe (in press). These sequences correlate to the Smoky Hollow (upper part), John Henry, and Drip Tank (lower part) Members of the Straight Cliffs Formation and include the informally named Calico and A-sandstones (fig. 4). Members and informally named units of the Straight Cliffs Formation were defined by Peterson (1969a, 1969b).

Drill sites were selected to augment outcrop studies at Left Hand Collet Canyon, Tibbet Canyon, and Rock House Cove (fig. 1) by Shanley and McCabe (1991), McCabe and Shanley (1992), and Shanley et al. (1992). Depositional facies and sequence stratigraphic relationships between the drill holes and outcrops are summarized in figure 4. The outcrops and drill hole localities are aligned roughly perpendicular to paleoshorelines of the Upper Cretaceous Western Interior Seaway.

FIELD WORK

CT-1-91 and SMP-1-91 were drilled during May and June, 1991 with a USGS owned and operated truck mounted rotary/core rig. Drilling was accomplished using compressed air with fresh water injection. Continuous 3-in. (7.6-cm) core was retrieved from each hole using a 20-ft- (6.1-m-) long, conventional core barrel with a split inner tube sampler. The core was oriented, calibrated, photographed, and briefly described in the field. Downhole depths were marked in 1-ft increments on the core. Caliper, natural gamma (gamma ray), bulk density, and spontaneous potential (SP) geophysical logs were recorded from each hole (p. 11-18). The core holes were filled with fresh water so that spontaneous potential logs could be recorded to the surface (natural ground-water levels were at downhole depths of 804 ft (245 m) in CT-1-91 and 57 ft (17 m) in SMP-1-91).

A total of 916 ft (279 m) of core (121 core boxes) was recovered between the depths of 141.1-1,057.4 ft (43.0-322.3 m) in CT-1-91. A total of 903 ft (275 m) of core (120 boxes) was recovered between the depths of 60.0-962.7 ft (18.3-293.4 m) in SMP-1-91. All cores of coal beds were placed into air-tight plastic bags. Cores of coal beds greater than 1 ft (0.3 m) in thickness were encased in PVC tubing and sent to the USGS, Branch of Coal Geology in Reston, Va., for analyses. The remainder of the core was sent to the USGS, Branch of Coal Geology in Denver, Colo., for analyses. All core and coal splits are being stored at the USGS, Core Research Library in Building 810 of the Denver Federal Center in Denver, Colo.

CORE DESCRIPTIONS AND PRELIMINARY INTERPRETATIONS

Detailed sedimentological features have been described from clean uncut surfaces of the core. These sedimentological features have been used to define four depositional assemblages in the core that are interpreted as: 1) shoreface, 2) tidal, 3) fluvial channel, and 4) floodplain deposits. Sedimentological features and depositional interpretations are shown on pages 19 through 50 in this report. Outcrop interpretations by Shanley and McCabe (1991), and Shanley et al. (1992) were used to augment these depositional interpretations. Characteristics of each depositional assemblage included with the core descriptions in this paper are summarized below:

Shoreface deposits

Shoreface deposits are dominated by swaley bedded sandstone and contain thin beds of conglomerate and trough cross-bedded, cross-laminated, and bioturbated sandstone. Fossils include oyster and inoceramid shell fragments, sharks teeth, and burrow traces.

Tidal deposits

Tidal deposits are comprised of interbedded sandstone and mudrock. Sandstone is trough cross-bedded, planar tabular cross-bedded, cross-laminated, horizontally-laminated, bioturbated, or convolute bedded. Mudrock is laminated, bioturbated, or convolute bedded. Tidal deposits are characterized by oyster, inoceramid, *Corbula*, and gastropod shell fragments, *Teredolites* borings, burrow traces, plant debris, inclined bedding, mud drapes, double mud drapes, and synaeresis cracks.

Fluvial channel deposits

Fluvial channel deposits typically overlie erosional surfaces and consist of upward-fining, multistoried, trough and planar cross-bedded sandbodies. The upper part of some sandbodies are cross-laminated, horizontally-laminated, or convolute bedded. Fluvial deposits with rare tidal features are considered to be tidally influenced.

Floodplain deposits

Floodplain deposits consist of coal, carbonaceous shale, massive mudrock, convolute bedded sandstone and mudrock, and sandstone. Sandstone is typically cross-laminated, horizontally laminated, bioturbated, trough cross-bedded, or planar tabular cross-bedded. Mudrock commonly contains roots and randomly oriented slickensides. Common fossils include roots, burrows, wood fragments, plant debris, and leaf imprints.

Preliminary sequence stratigraphic interpretations that are included with the core descriptions (p. 19-50) are based on depositional stacking patterns that are similar to those described from outcrops of the Straight Cliffs Formation by Shanley and McCabe (1991), and Shanley et al. (1992). Sequence stratigraphic nomenclature has been defined by Shanley and McCabe (1991, and in press). Three significant unconformities are interpreted in the core from basinward facies shifts that displace coarser grained fluvial (braided river) and tidally influenced fluvial rocks over finer grained shoreface and coastal plain strata. Each unconformity is interpreted to reflect a fall in relative base-level. The unconformities correlate (from oldest to youngest) with the Calico, A-, and Drip Tank sequence boundaries (fig. 4) defined by Shanley and McCabe (1991). Strata truncated by the Calico sequence boundary are included within the Tibbet sequence. Strata between the Calico and A-sequence boundaries are within the Calico sequence. Strata between the A- and Drip Tank sequence boundaries are within the A-sandstone sequence. The Calico and A-sandstone sequences each contain a transgressive and superposed highstand systems tract. Only the upper part of the highstand systems tract was retrieved from the Tibbet sequence. Each transgressive systems tract overlies a sequence boundary and is characterized by a deepening-upward succession of strata that suggest a relative base-level rise. Each highstand systems tract is characterized by progradational

stacking patterns and is truncated by a sequence boundary unconformity, suggesting a decrease in relative base-level rise and subsequent relative base-level fall.

ACKNOWLEDGMENTS

I wish to thank Peter J. McCabe and Diane L. Kamola for the assistance they provided with facies and trace fossil identifications. I also thank Bill Whitus, Brenda Pierce, Art Clark, and the USGS drill crew for the assistance they provided in the field.

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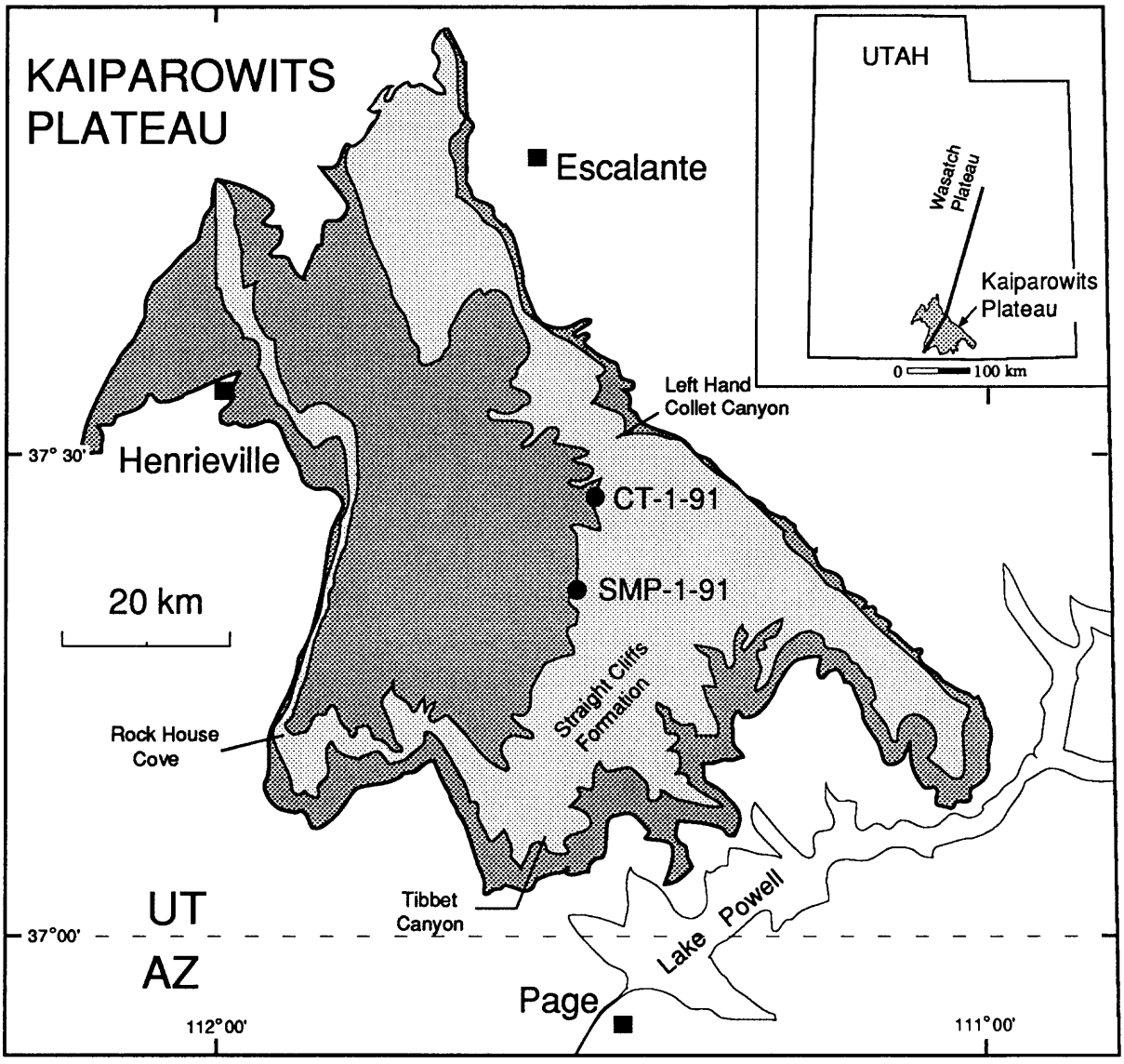


Figure 1.-- Map showing locations of Kaiparowits Plateau, core holes CT-1-91 and SMP-1-91, and line of section in figure 4. Area of Kaiparowits Plateau is shown in dark gray and includes outcrops of Straight Cliffs Formatiom shown in light gray.

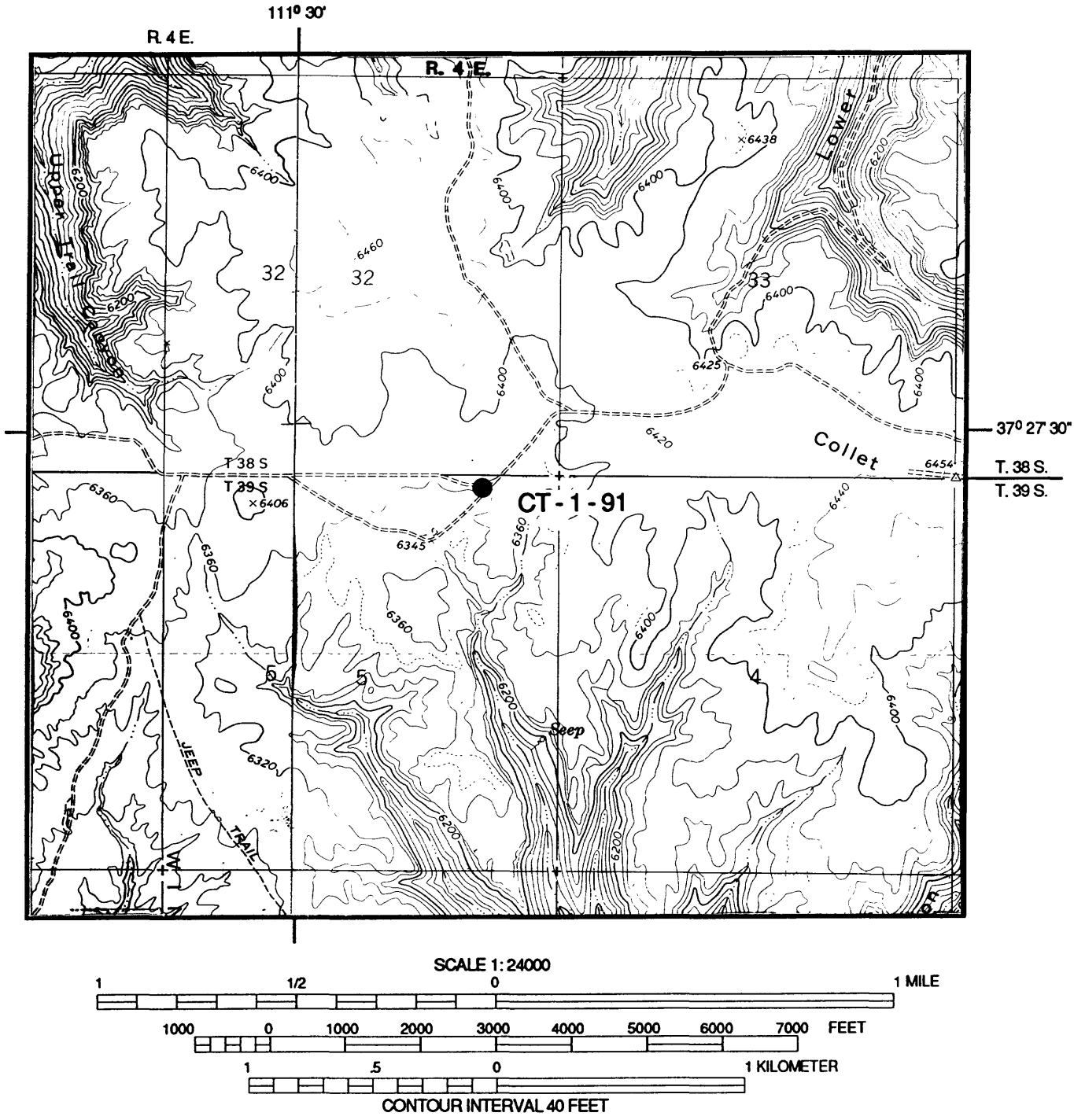


Figure 2. -- Map showing location of core hole CT-1-91 in the Collet Top 7.5' topographic quadrangle, Utah. CT-1-91 is located 60 m (200 ft) from the north line and 305 m (1000 ft) from the east line of sec. 5, T. 39 S., R. 4 E. (latitude: 37° 27' 22", longitude: 111° 29' 27"), at an elevation of 1,942 m (6,370 ft) above mean sea level.

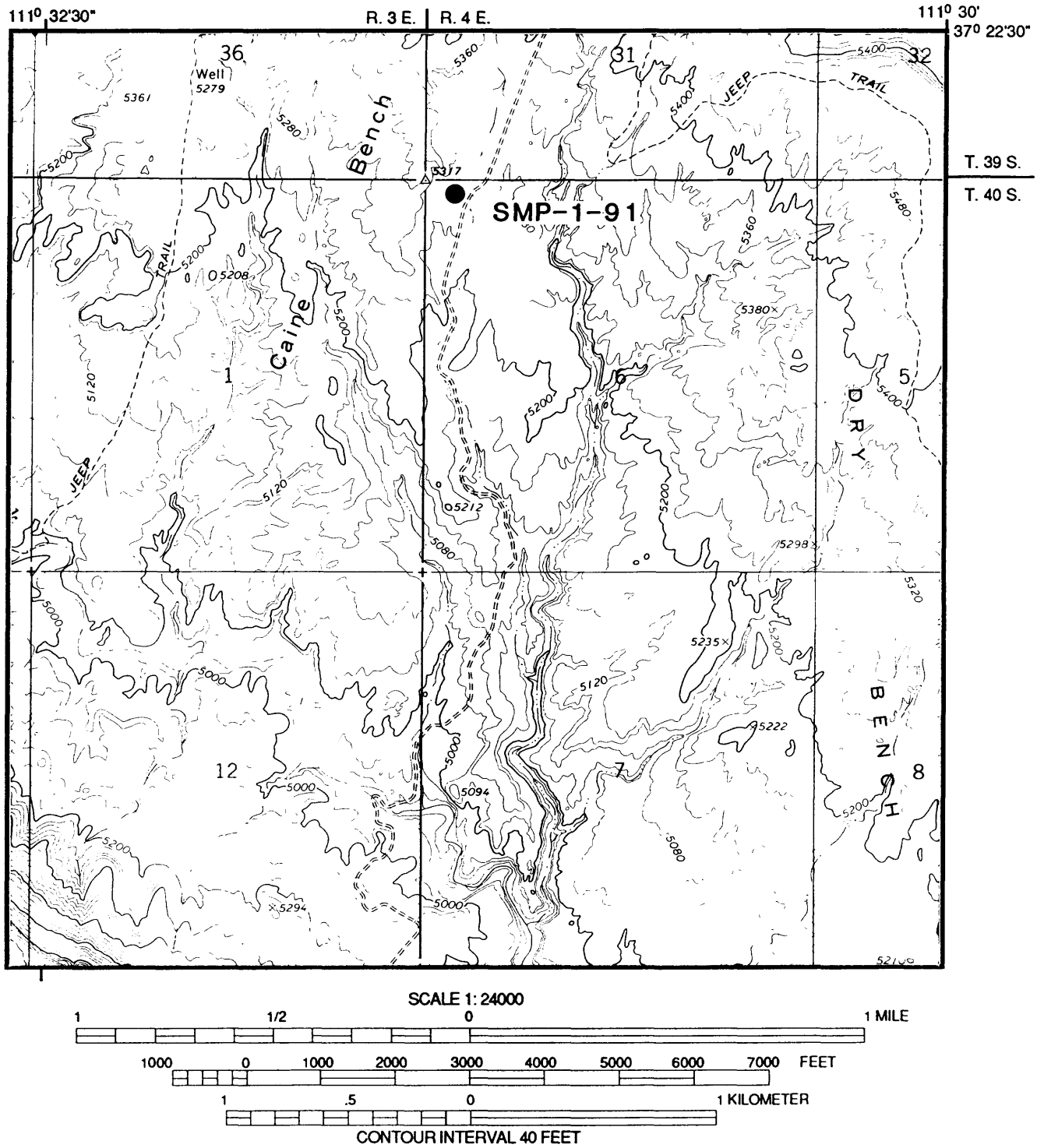


Figure 3. -- Map showing location of core hole SMP-1-91 in the Ship Mountain Point 7.5' topographic quadrangle, Utah. SMP-1-91 is located 60 m (200 ft) from the north line and 122 m (400 ft) from the west line of sec. 6, T. 40 S., R. 4 E. (latitude: 37° 22' 9", longitude: 111° 31' 19"), at an elevation of 1,599 m (5247 ft) above mean sea level.

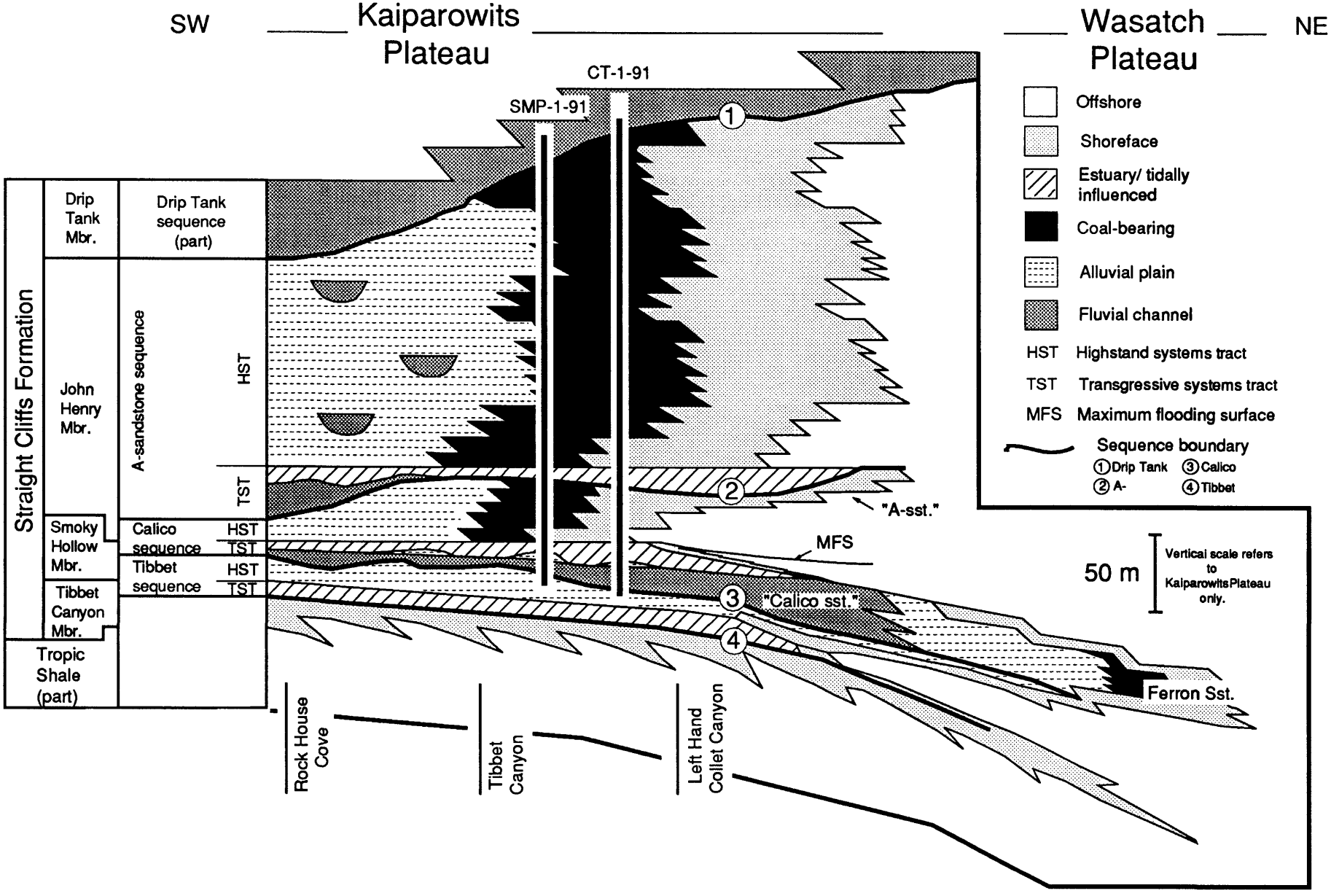


Figure 4. -- Diagram showing facies relationships in Turonian through Campanian strata of the Kaiparowits and Wasatch Plateaus, Utah. Line of section is shown in figure 1. Core holes are shown with respect to depositional sequences and stratigraphic studies in Left Hand Collet Canyon, Tibbet Canyon, and Rock House Cove (Shanley and McCabe, 1991; Shanley et al., 1992; and McCabe and Shanley, 1992). Diagram is modified from Shanley (1991), Shanley et al. (1992), and Hettinger et al. (in press).

KEY TO CORE DESCRIPTIONS

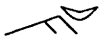

Trough or planar tabular cross-stratificaton

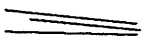

Ripple cross-lamination


Swaley cross-stratification


Wavy bedding


Lenticular or streaky bedding


Flaser bedding


Horizontal or subhorizontal bedding


Convoluted bedding

Mud or carbonaceous drapes


Double mud / carbonaceous drapes


Erosional contact

Sharp contact


Coal


Carbonaceous shale

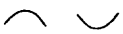

Granules

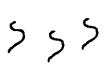

Mud clasts


Extraformational pebbles


Escape structure


Gastropod shell


Bivalve shell debris
(includes *Inoceramus*, oyster, and *Corbula* shell fragments)


Bioturbated

Burrowed

burrows include: *Ophiomorpha*, *Thalassinoides*, *Planolites*, *Teichichnus*, *Scoyenia*, *Cylindrichnus*, *Palaeophycus*

SC — Siderite concretion


Wood debris

(wood debris may contain *Teredolites* borings)


Roots

P — Plant debris (finely disseminated)


Coalified plant debris

x x x — Volcanic ash (at depth of 817.2 ft, CT-1-91)

Dash lines indicate very faint sedimentary structures.

Inclined symbols indicate inclined bedding.

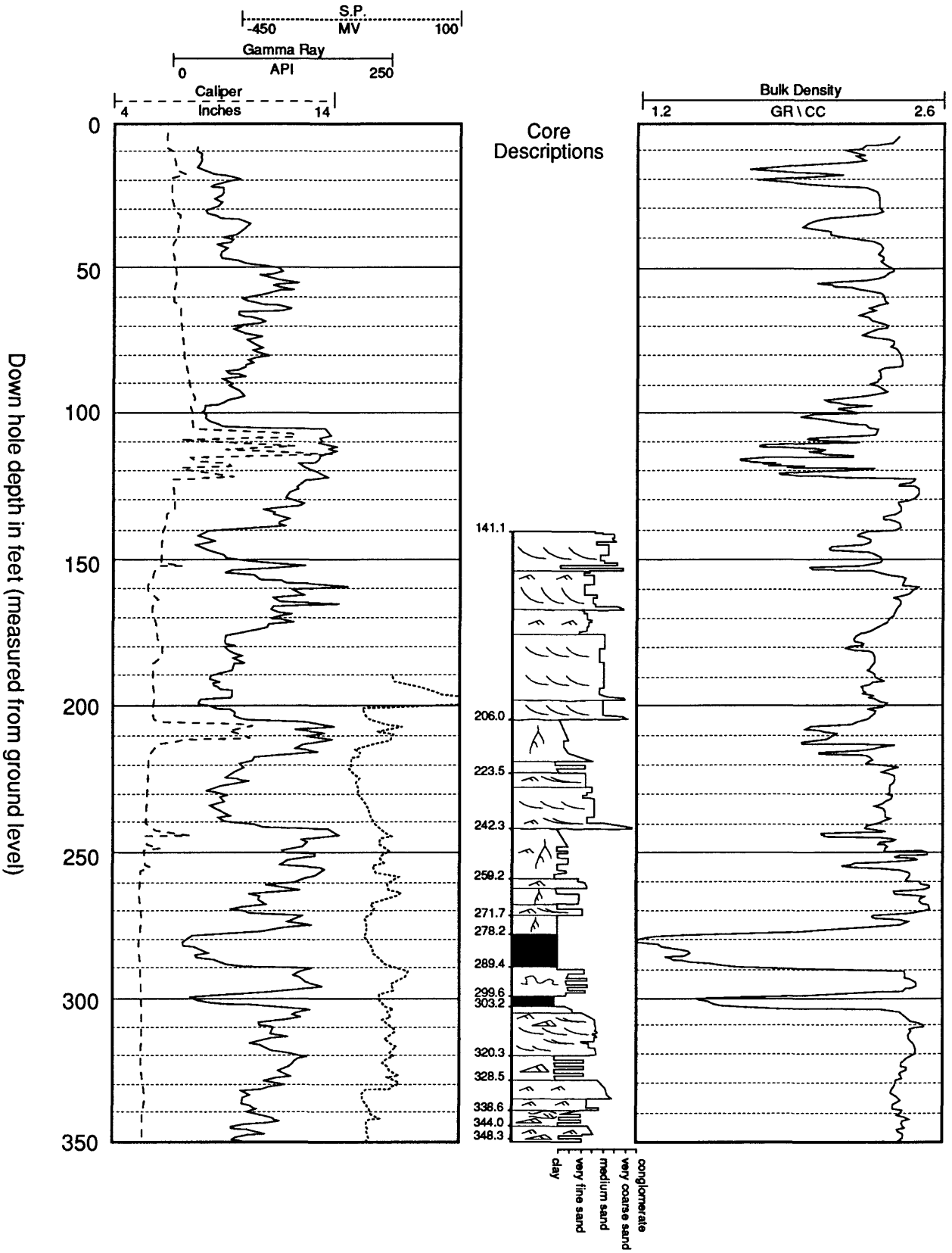
GRAIN SIZE:

c l - clay
s - silt
vf - very fine grained sand
f - fine grained sand
m - medium grained sand
c - coarse grained sand
vc - very coarse grained sand
cgl - conglomerate

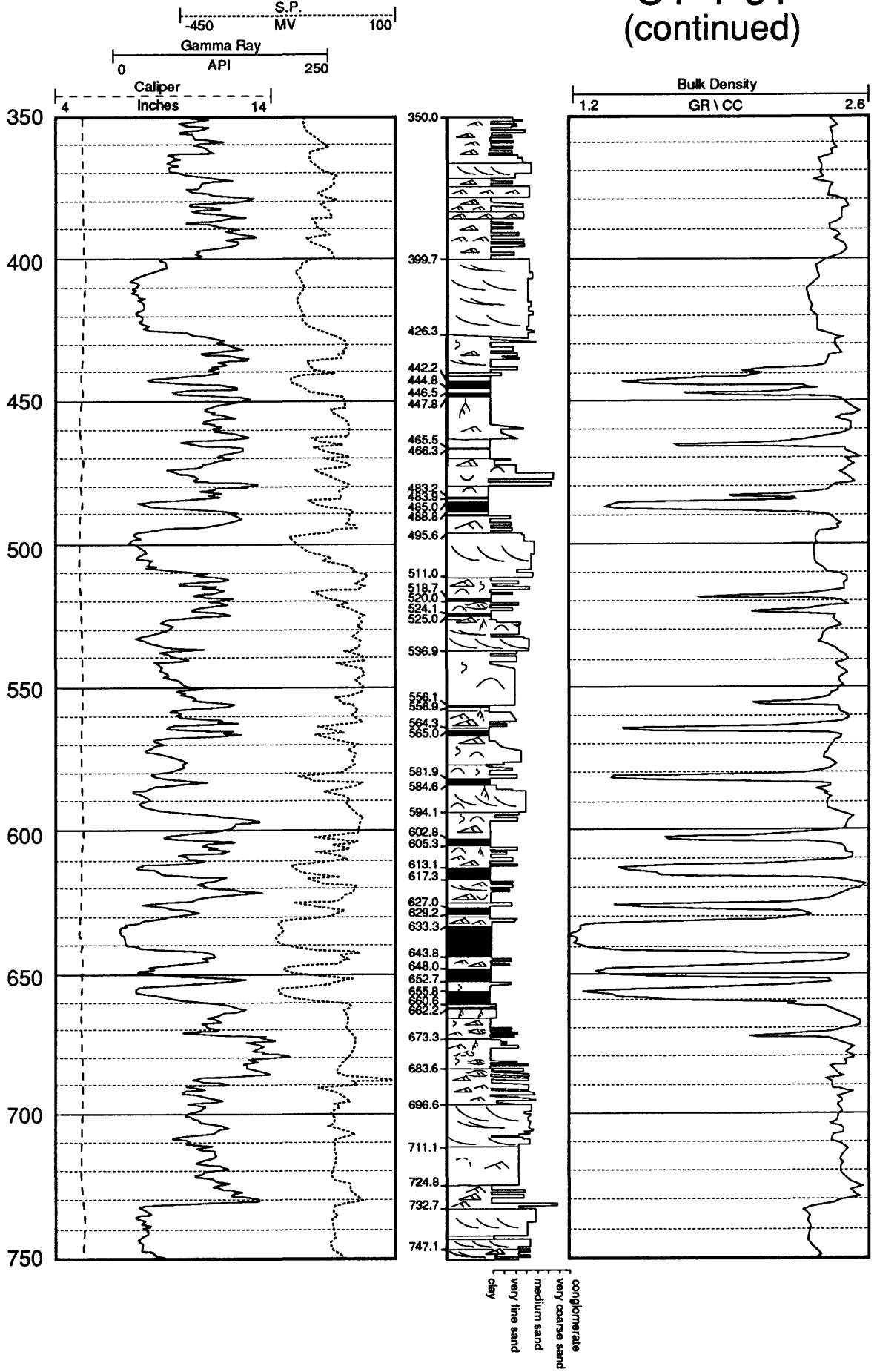
GEOPHYSICAL LOGS AND GENERALIZED DESCRIPTIONS FOR CORE CT-1-91

(symbols are explained on p. 10)

CT-1-91

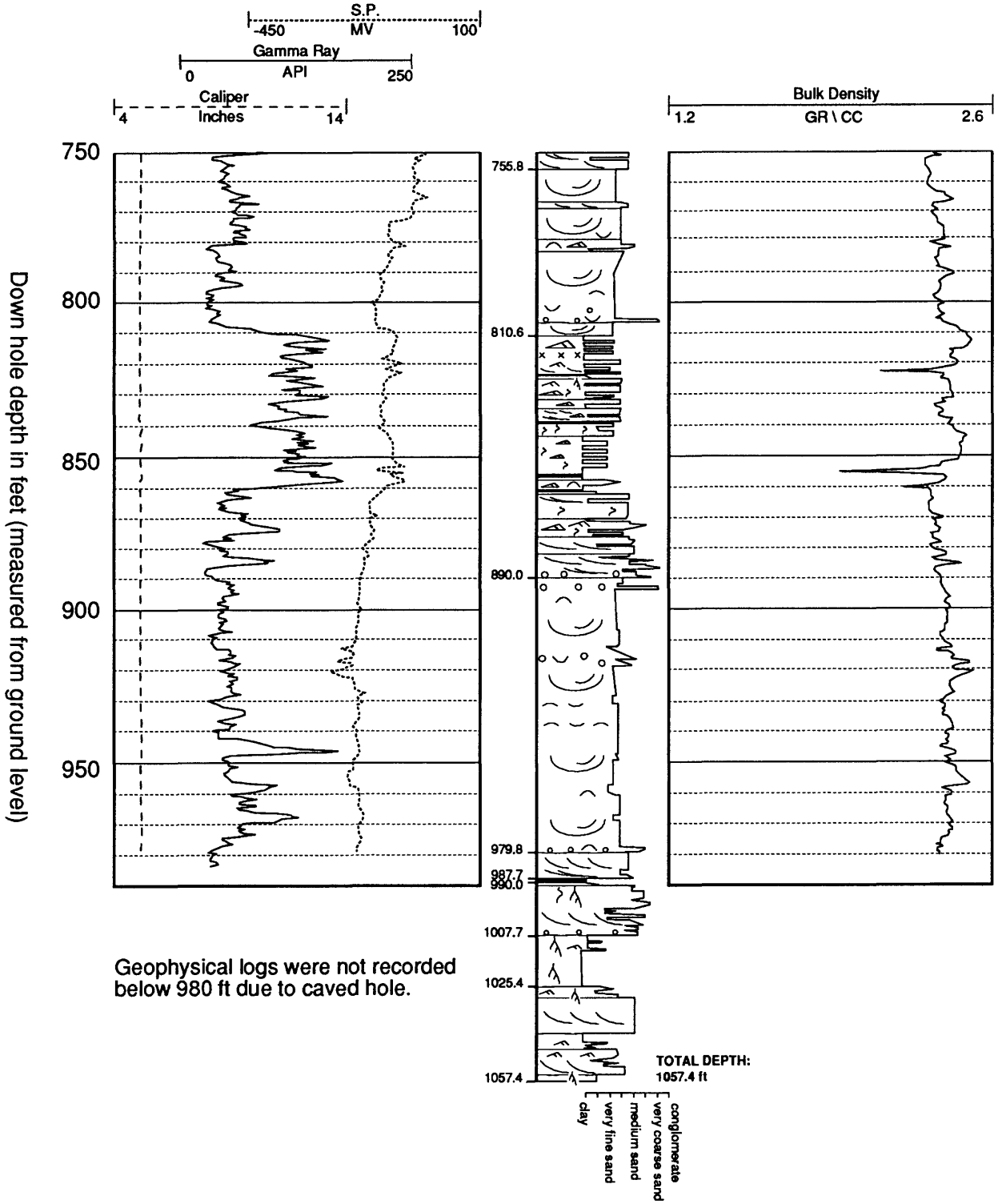

S.P.
-450
MV
100
Gamma Ray
0
API
250
Caliper
4
Inches
14
Bulk Density
1.2
GR \ CC
2.6
Core Descriptions
Down hole depth in feet (measured from ground level)
0
50
100
150
200
250
300
350
141.1
206.0
223.5
242.3
259.2
271.7
278.2
289.4
299.6
303.2
320.3
328.5
338.6
344.0
348.3
clay
very fine sand
medium sand
very coarse sand
conglomerate

CT-1-91
(continued)



Down hole depth in feet (measured from ground level)

CT-1-91
(continued)



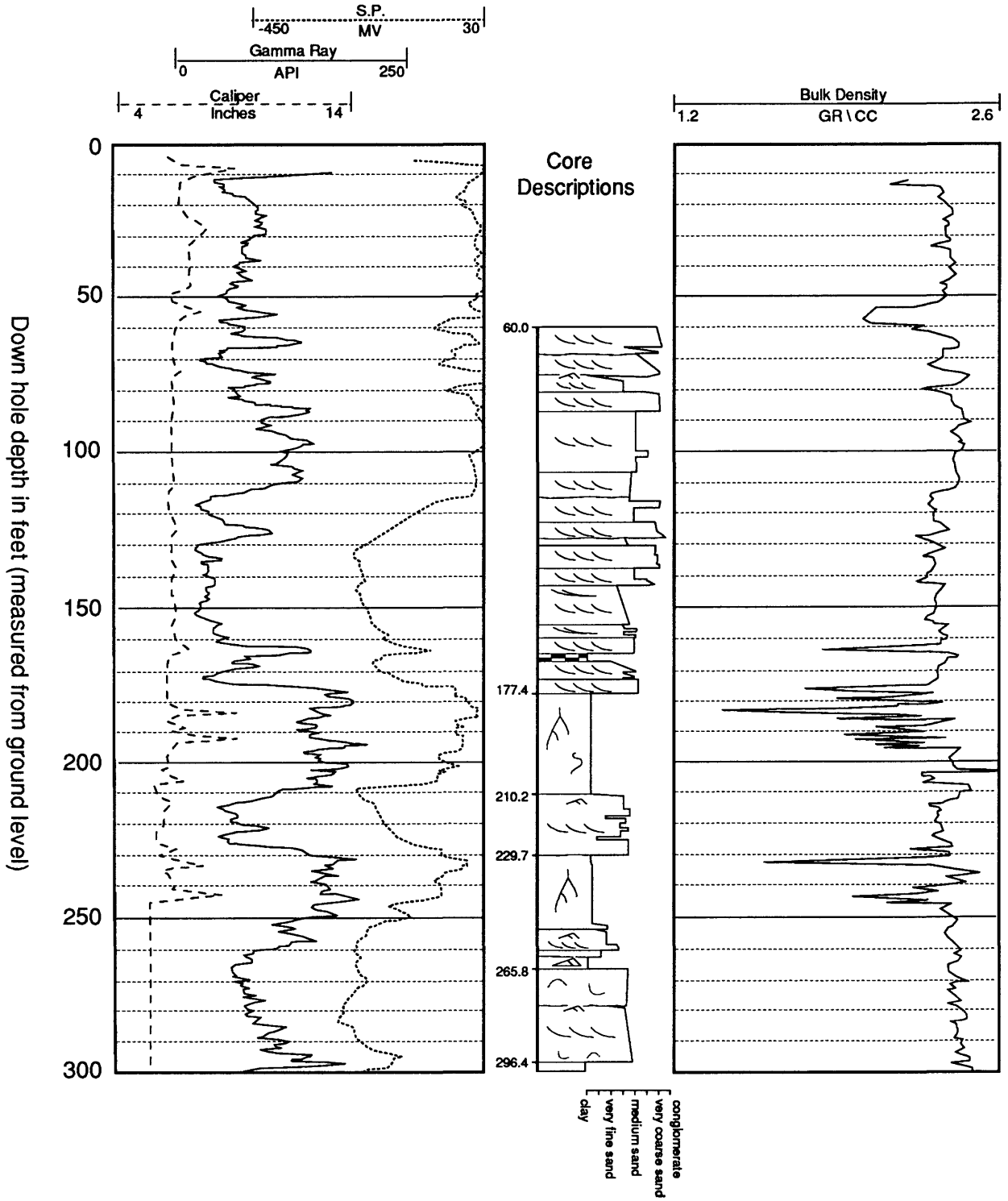
Geophysical logs were not recorded below 980 ft due to caved hole.

GEOPHYSICAL LOGS AND GENERALIZED DESCRIPTIONS FOR CORE SMP-1-91*[1]

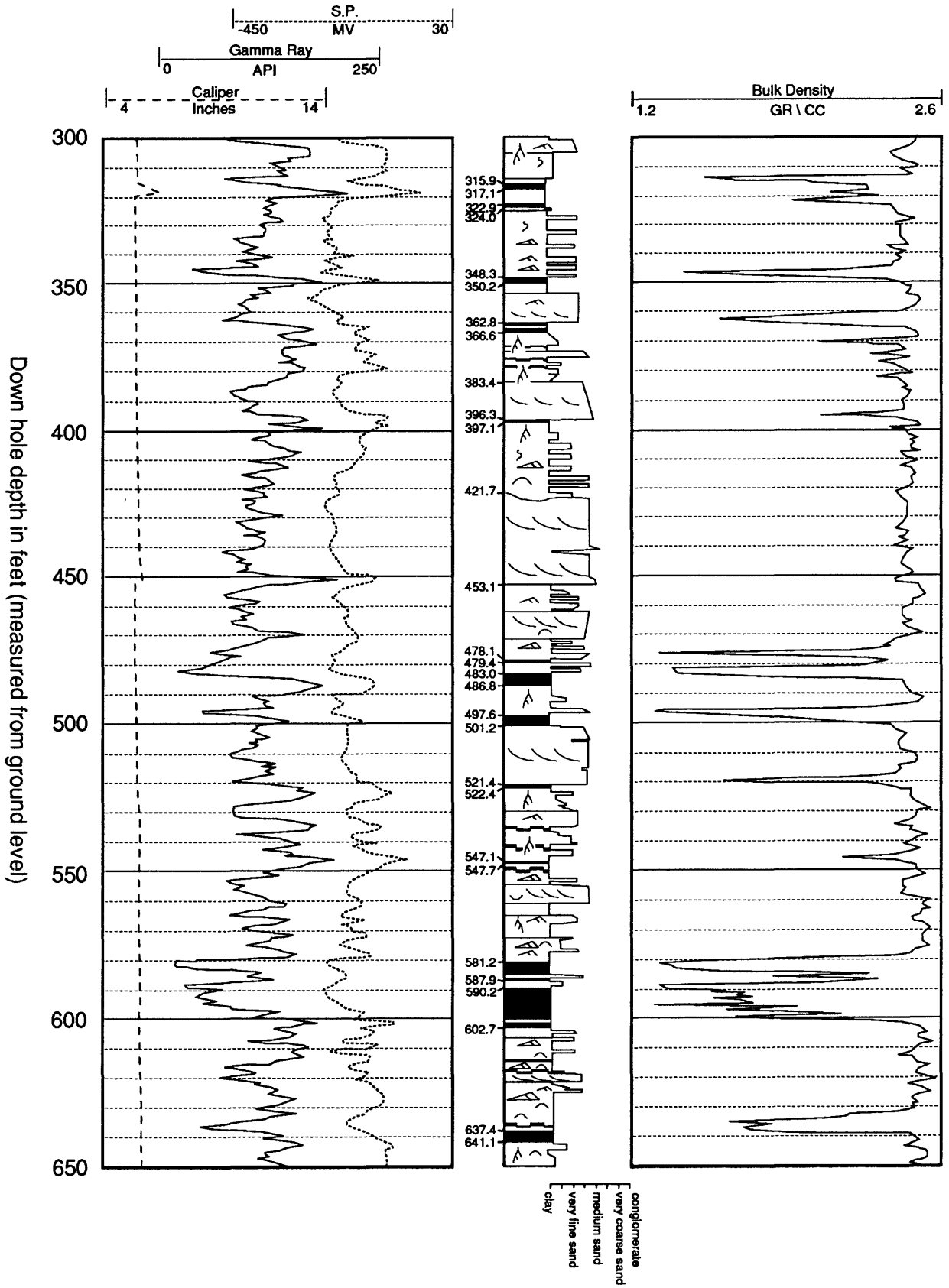
(symbols are explained on p. 10)

* [1] Geophysical logs from SMP-1-91 record lithologies at depths approximately 2 ft higher than core descriptions.

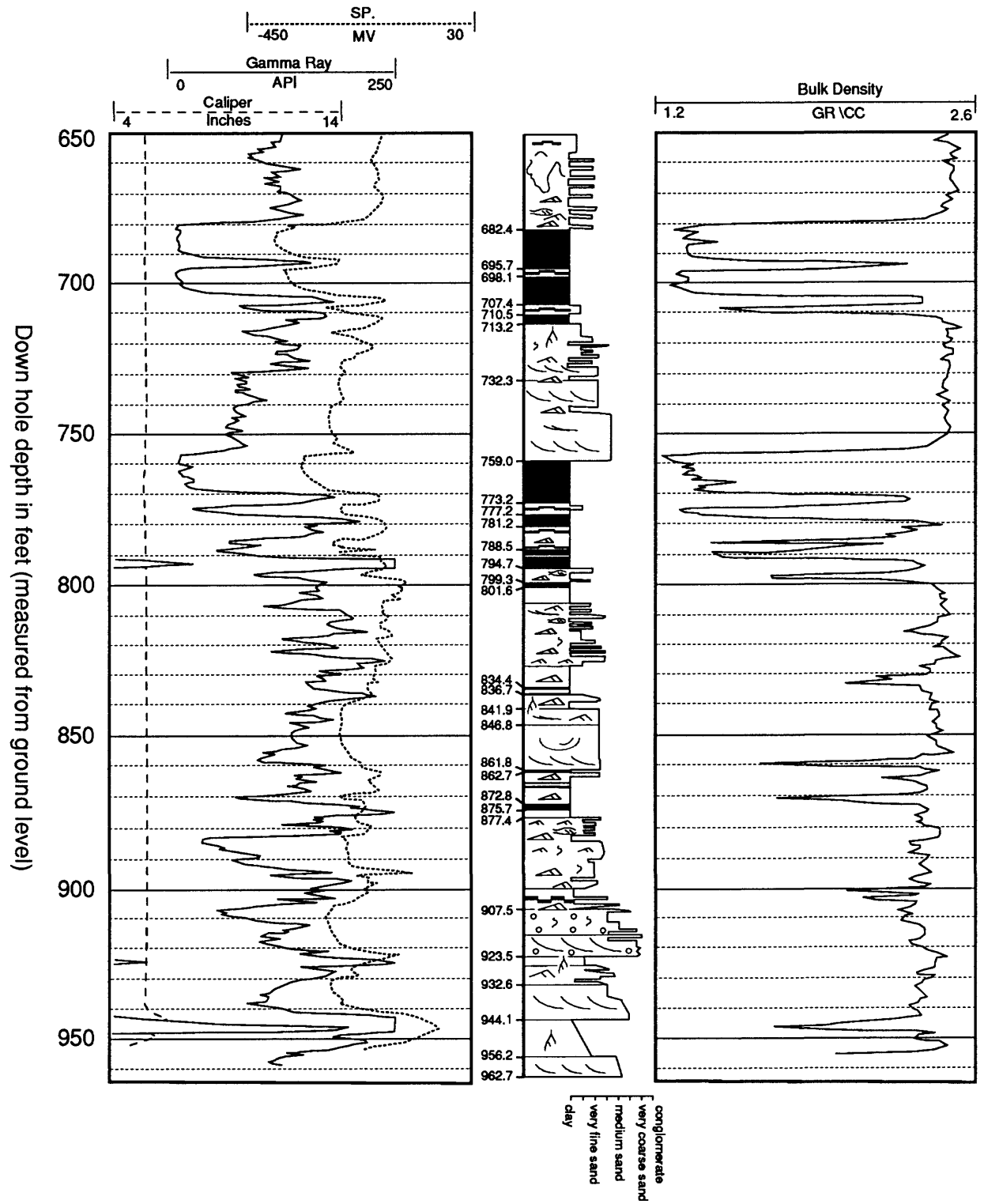
SMP-1-91


S.P.
-450
MV
30
Gamma Ray
0
API
250
Caliper
Inches
4
14
Bulk Density
1.2
GR \ CC
2.6
Core
Descriptions
Down hole depth in feet (measured from ground level)
0
50
100
150
200
250
300
60.0
177.4
210.2
229.7
265.8
296.4
clay
very fine sand
medium sand
very coarse sand
conglomerate

SMP-1-91
(continued)



SMP-1-9
(continued)

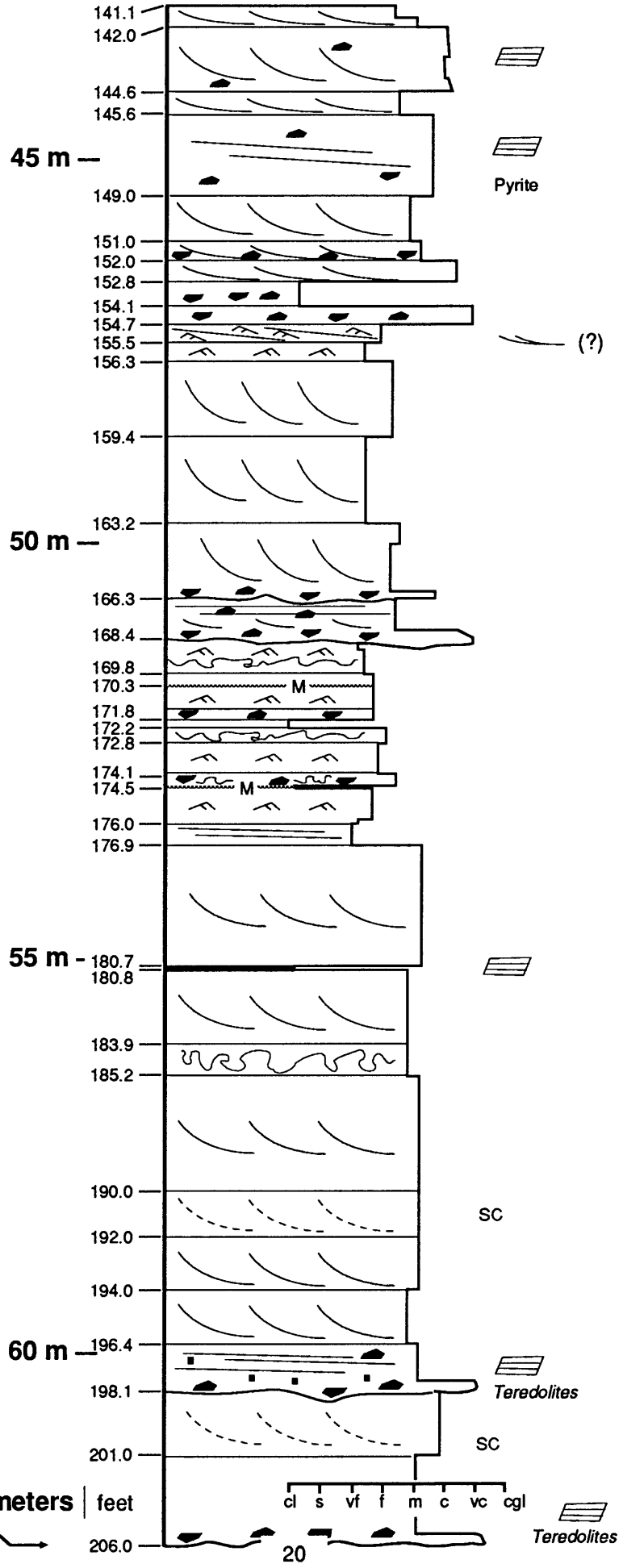


DETAILED DESCRIPTIONS AND PRELIMINARY INTERPRETATIONS FOR CORE CT-1-91

(symbols are explained on p. 10)

CT-1-91

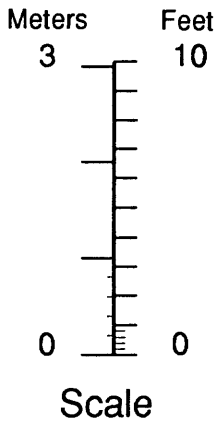
Down hole depth:
43.0 to 62.8 m
(141.1 to 206.0 ft)

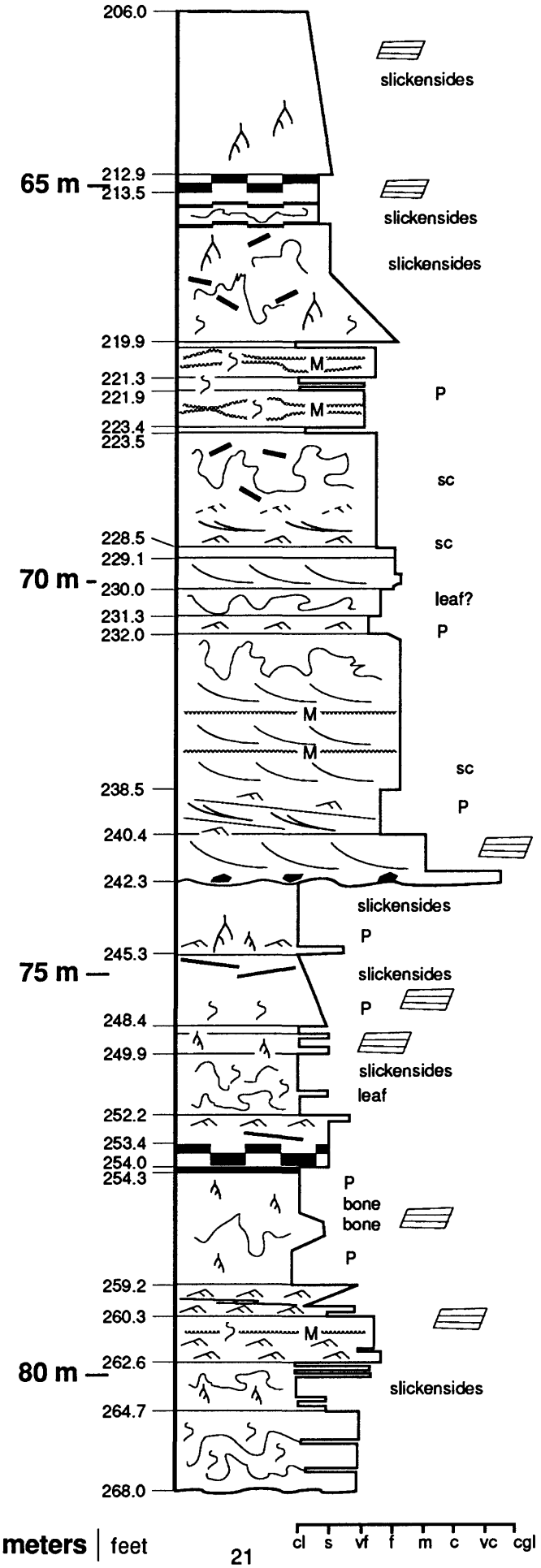


CT-1-91

(continued)

Down hole depth:
62.8 to 81.7 m
(206.0 to 268.0 ft)

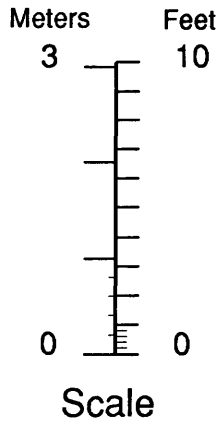


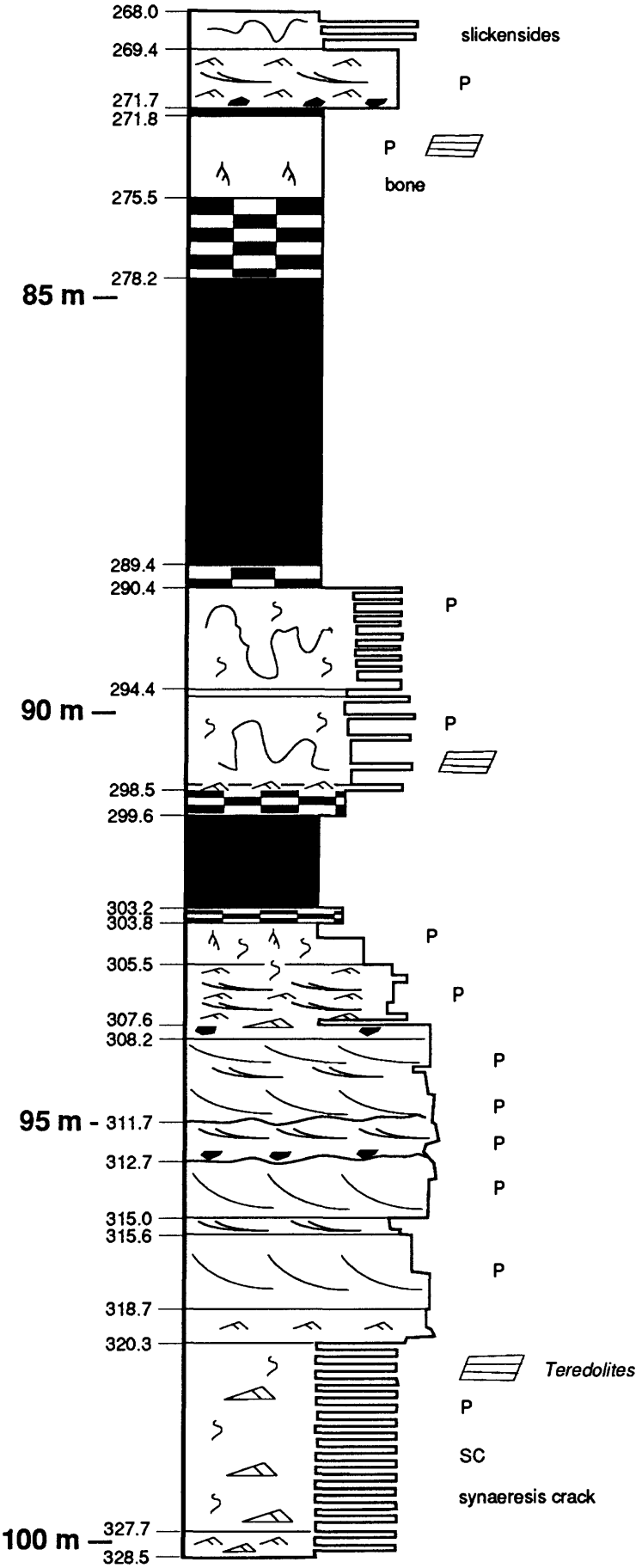


CT-1-91

(continued)

Down hole depth:
81.7 to 100.1 m
(268.0 to 328.5 ft)





Floodplain

Tidal

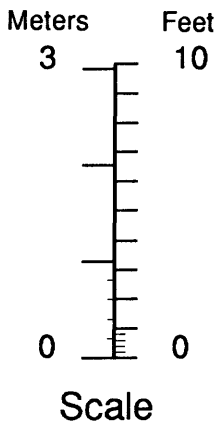
Floodplain

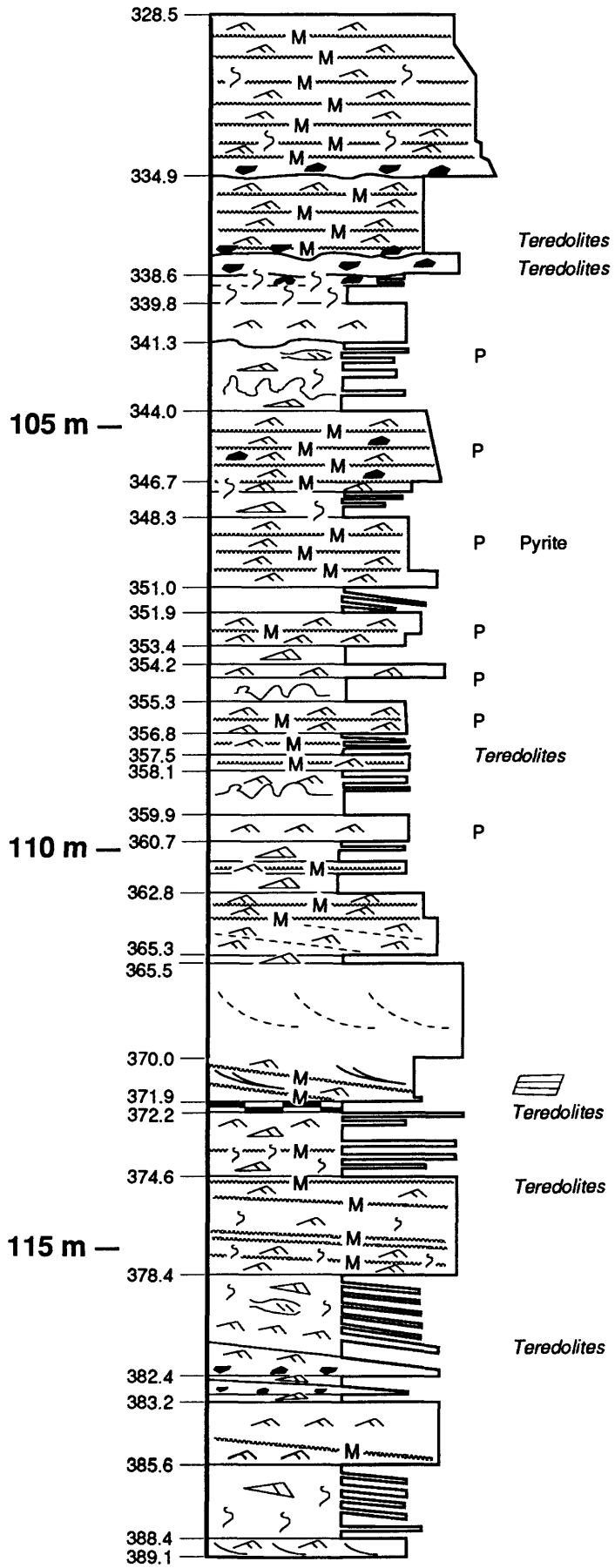
Tidal

CT-1-91

(continued)

Down hole depth:
100.1 to 118.6 m
(328.5 to 389.1 ft)

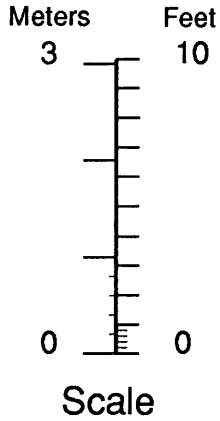


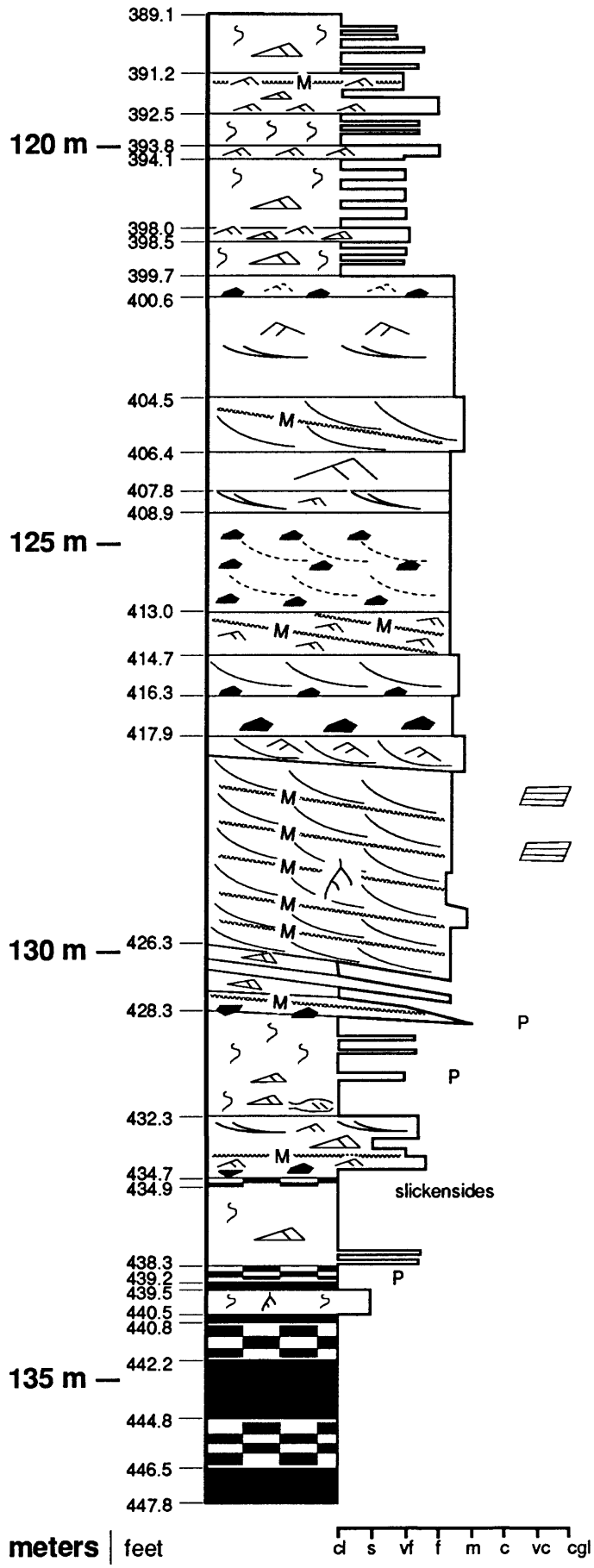


CT-1-91

(continued)

Down hole depth:
118.6 to 136.5 m
(389.1 to 447.8 ft)





Tidal

Floodplain

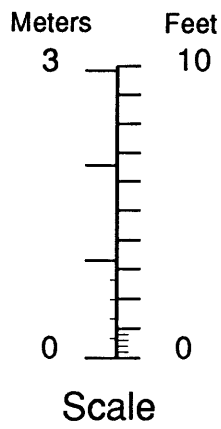
Tidal

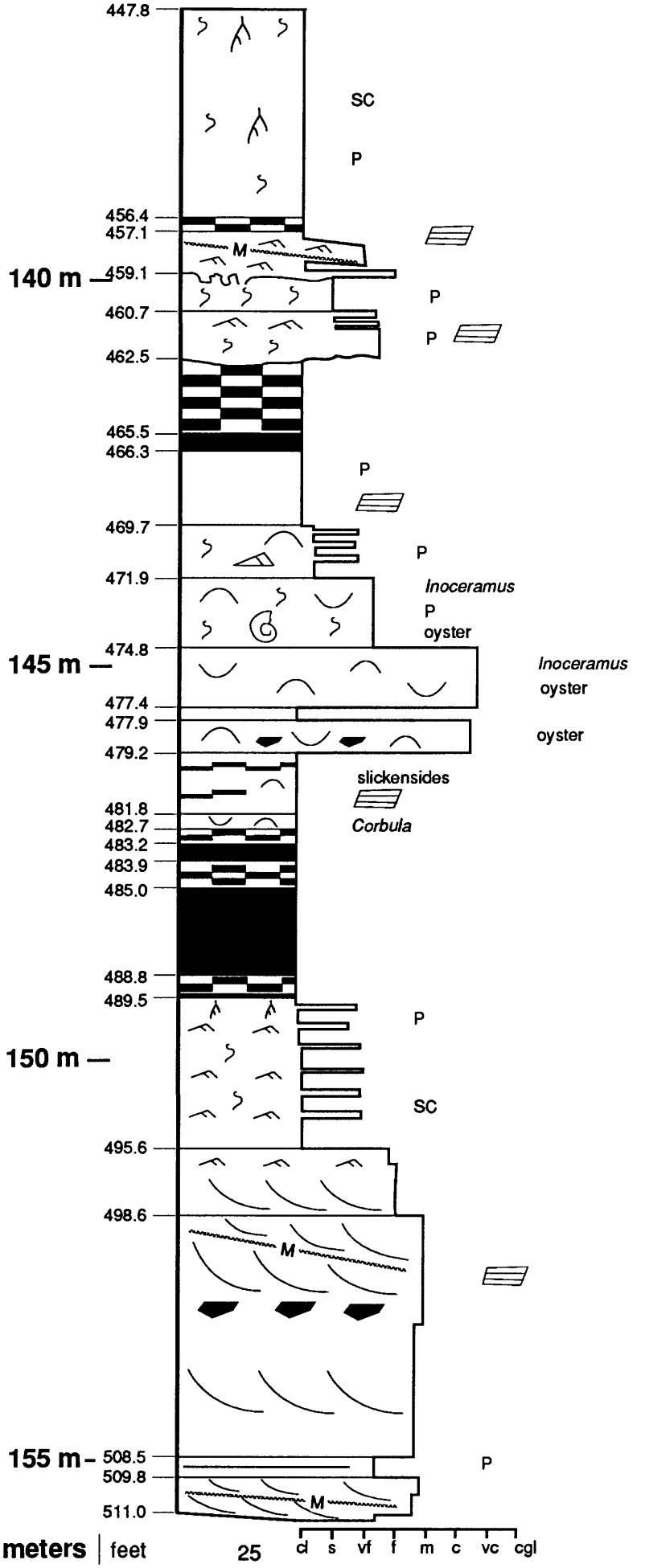
Floodplain

CT-1-91

(continued)

Down hole depth:
136.5 to 155.7 m
(447.8 to 511.0 ft)

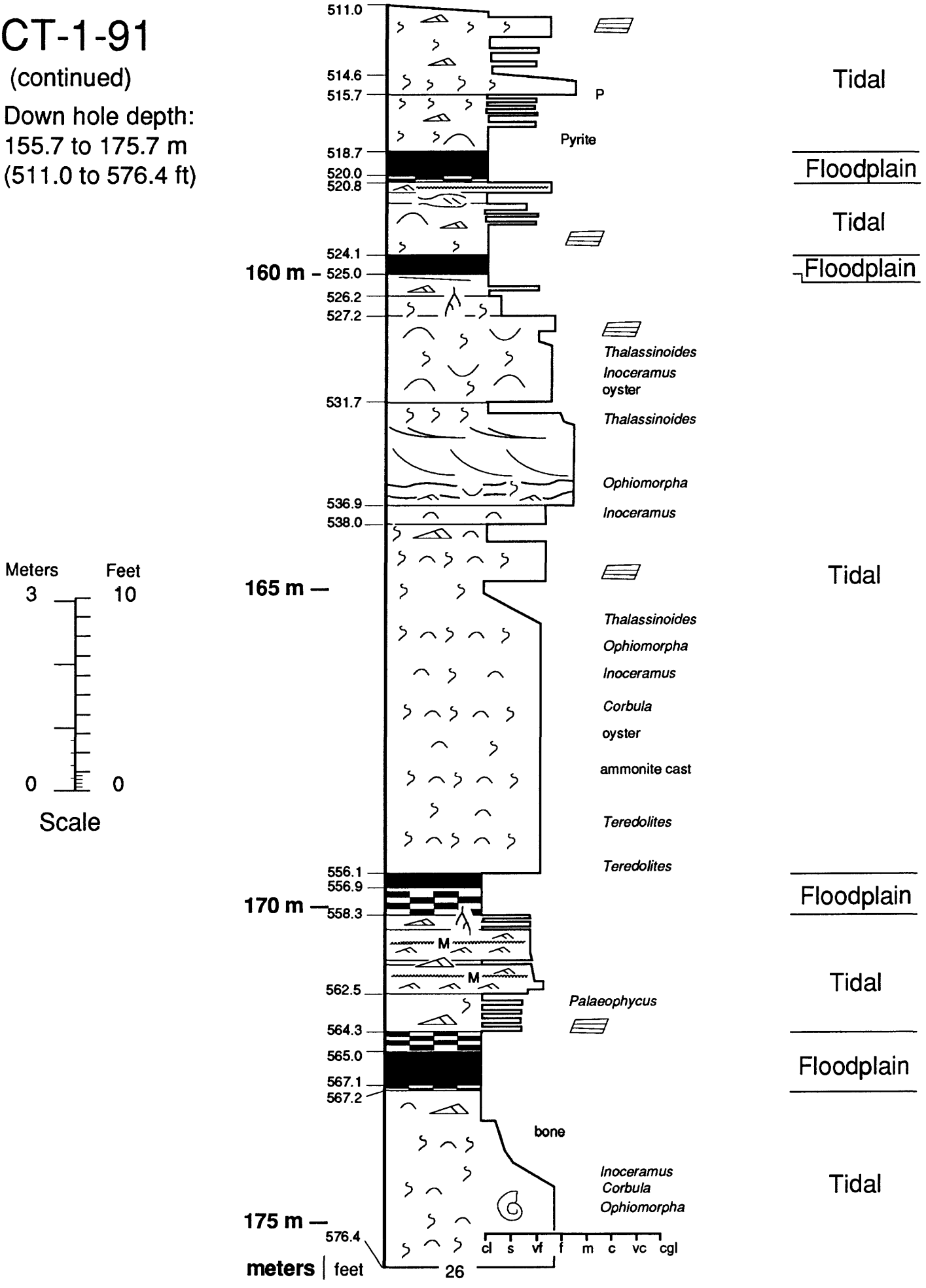




CT-1-91

(continued)

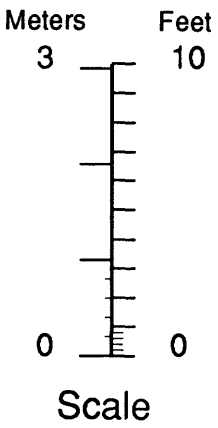
Down hole depth:
155.7 to 175.7 m
(511.0 to 576.4 ft)

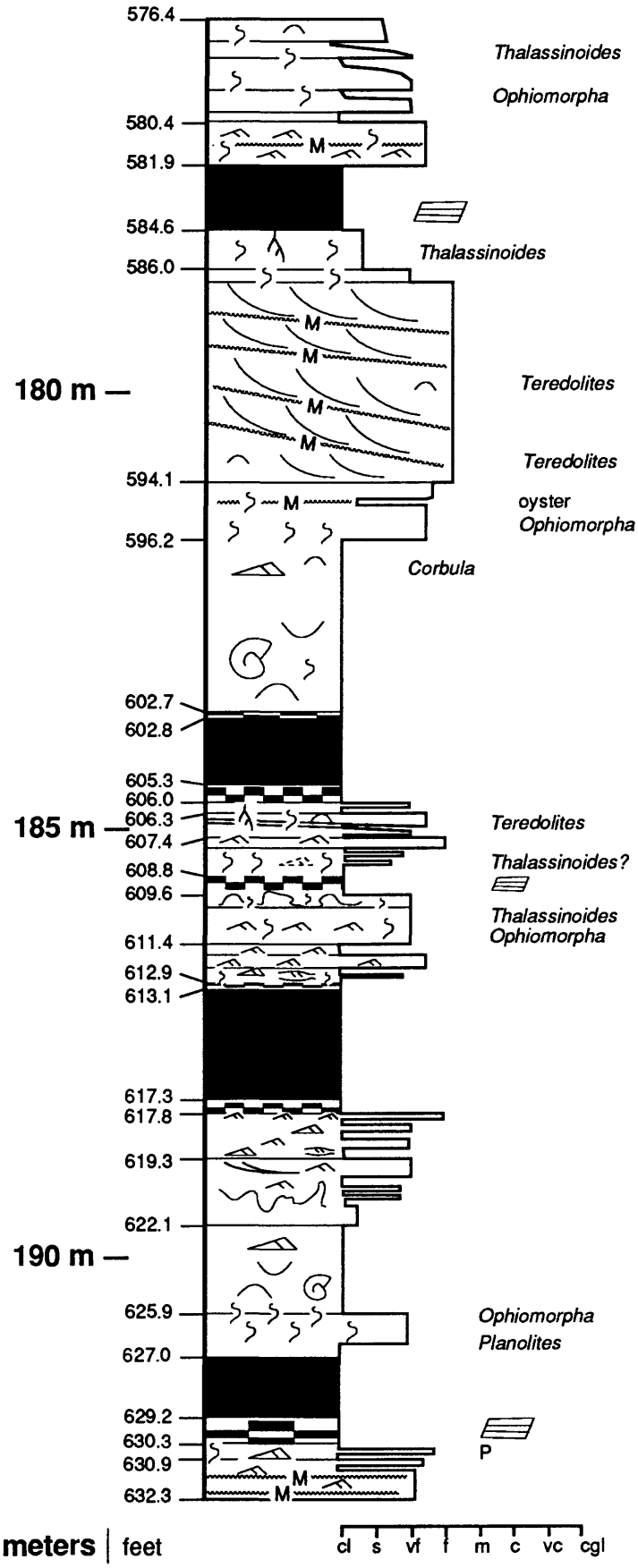


CT-1-91

(continued)

Down hole depth:
175.7 to 192.7 m
(576.4 to 632.3 ft)





Tidal

Floodplain

Tidal

Floodplain

Tidal

Floodplain

Tidal

Floodplain

Tidal

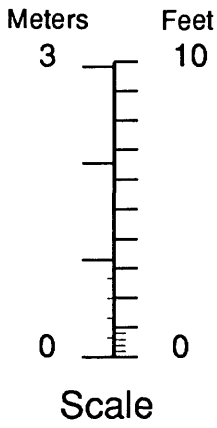
Floodplain

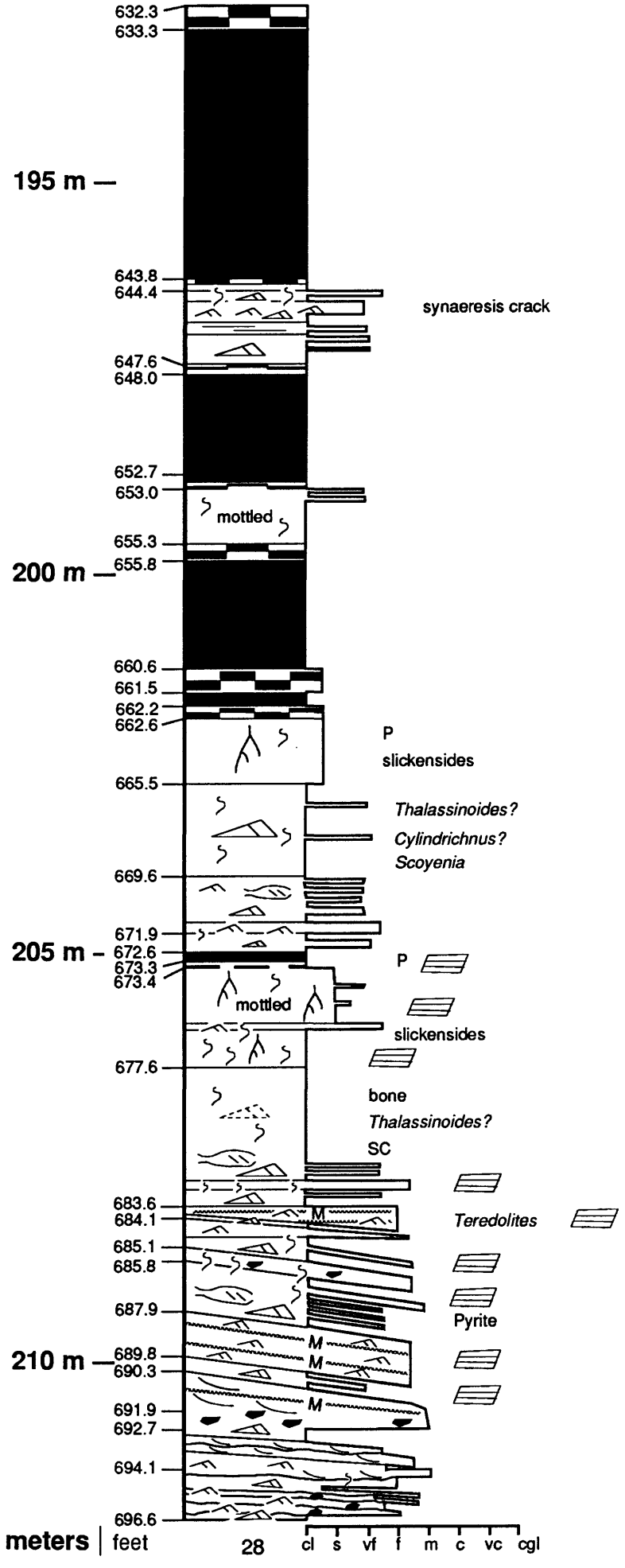
Tidal

CT-1-91

(continued)

Down hole depth:
192.7 to 212.3 m
(632.3 to 696.6 ft)

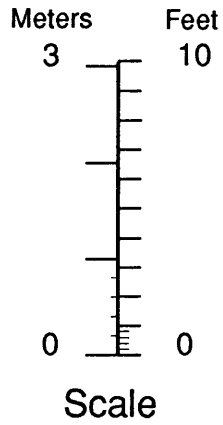


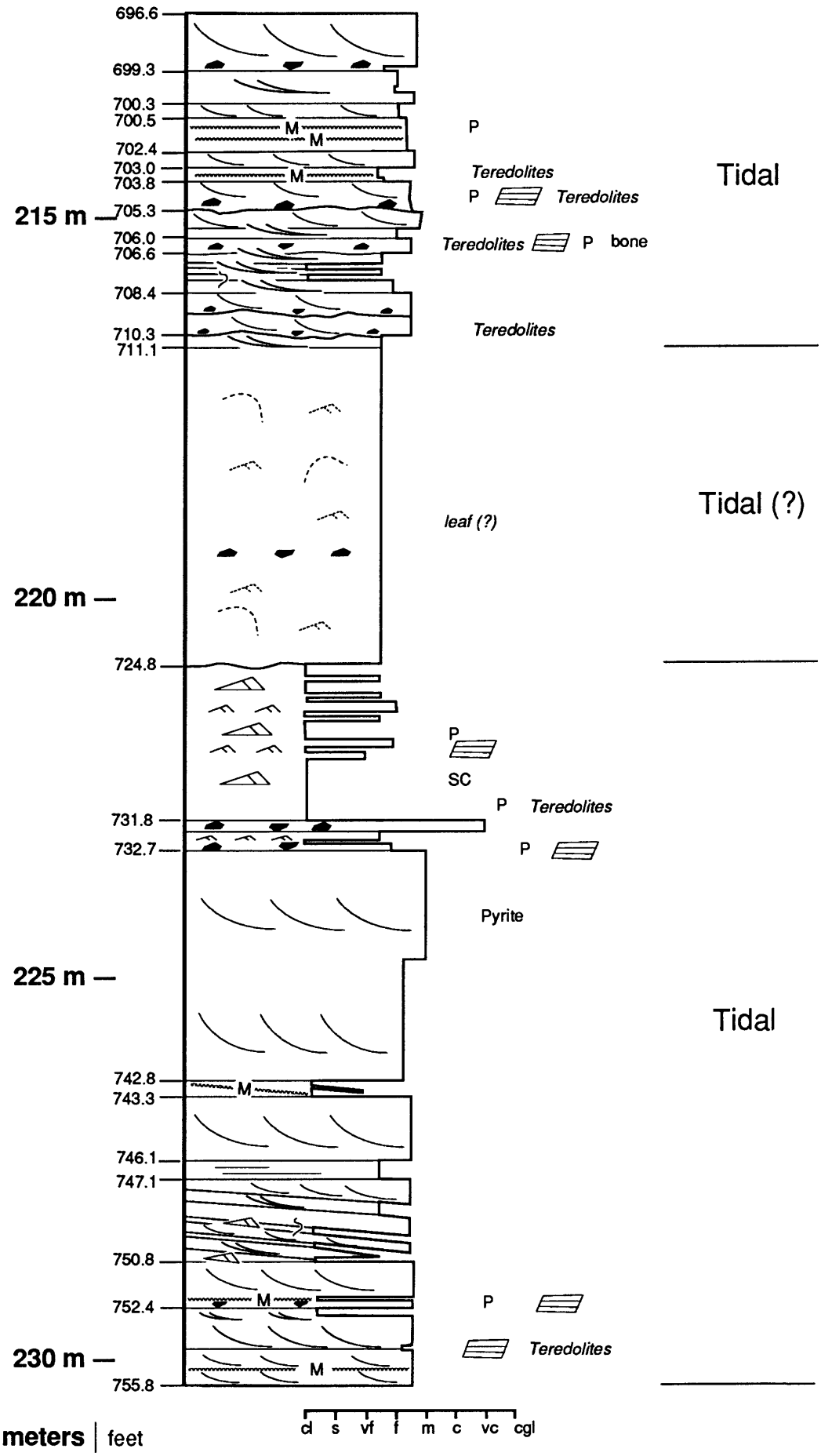


CT-1-91

(continued)

Down hole depth:
212.3 to 230.4 m
(696.6 to 755.8 ft)

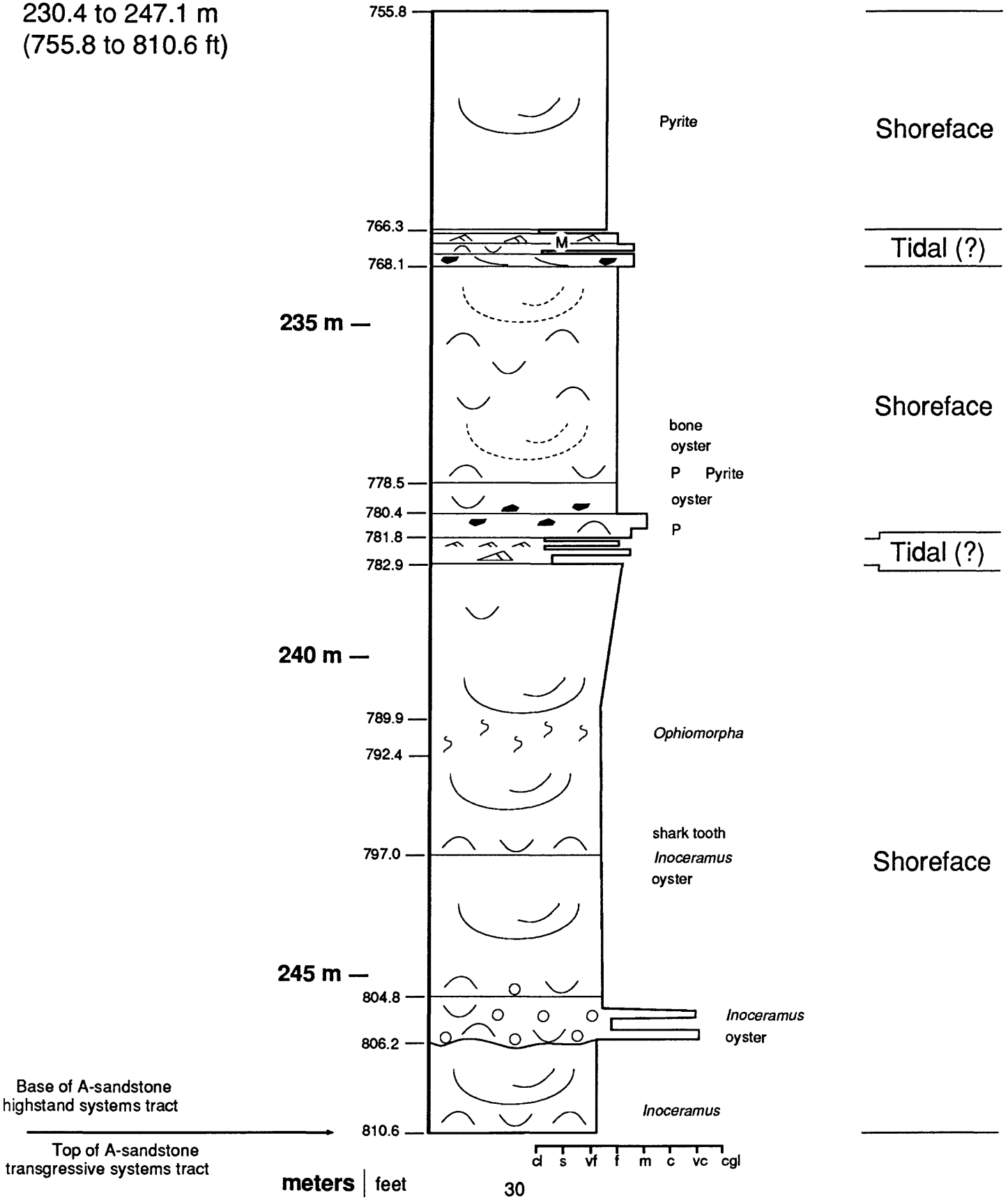




CT-1-91

(continued)

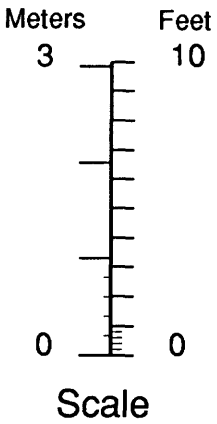
Down hole depth:
230.4 to 247.1 m
(755.8 to 810.6 ft)

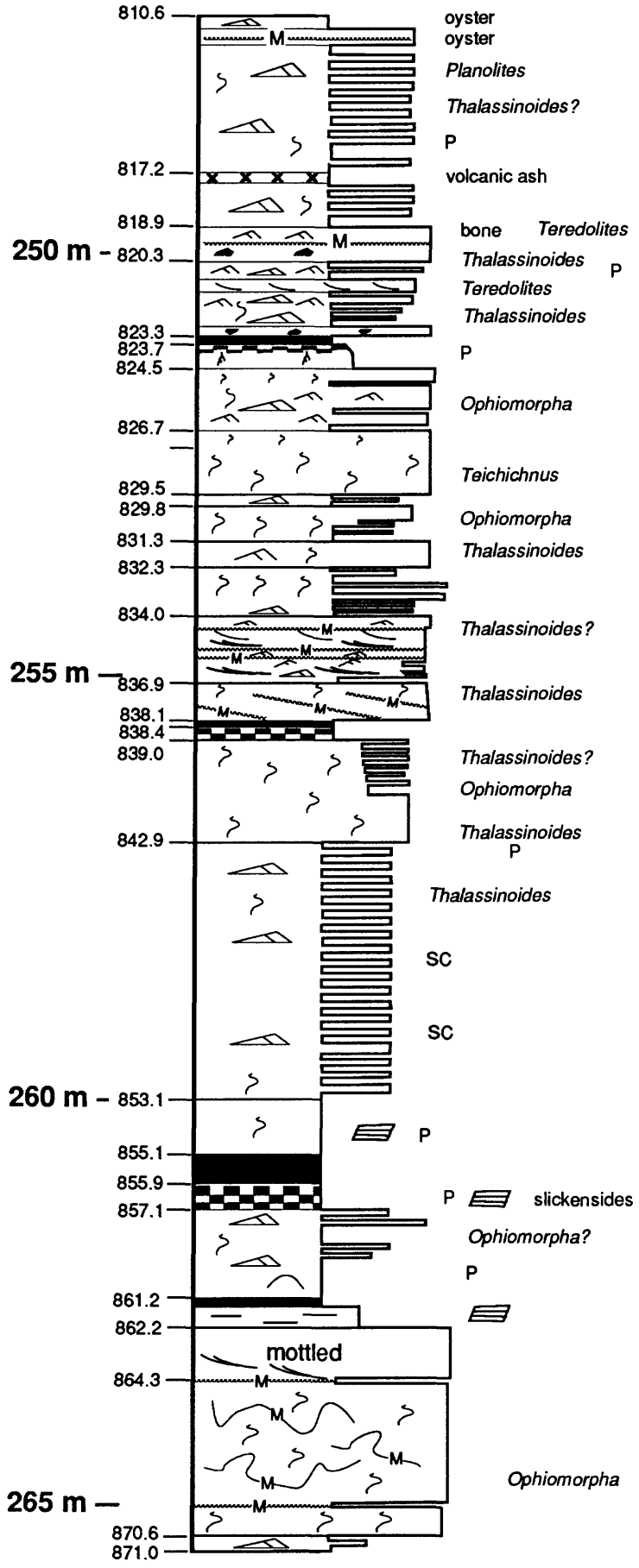


CT-1-91

(continued)

Down hole depth:
247.1 to 265.5 m
(810.6 to 871.0 ft)





Tidal

Floodplain

Tidal

Floodplain

Tidal

Floodplain

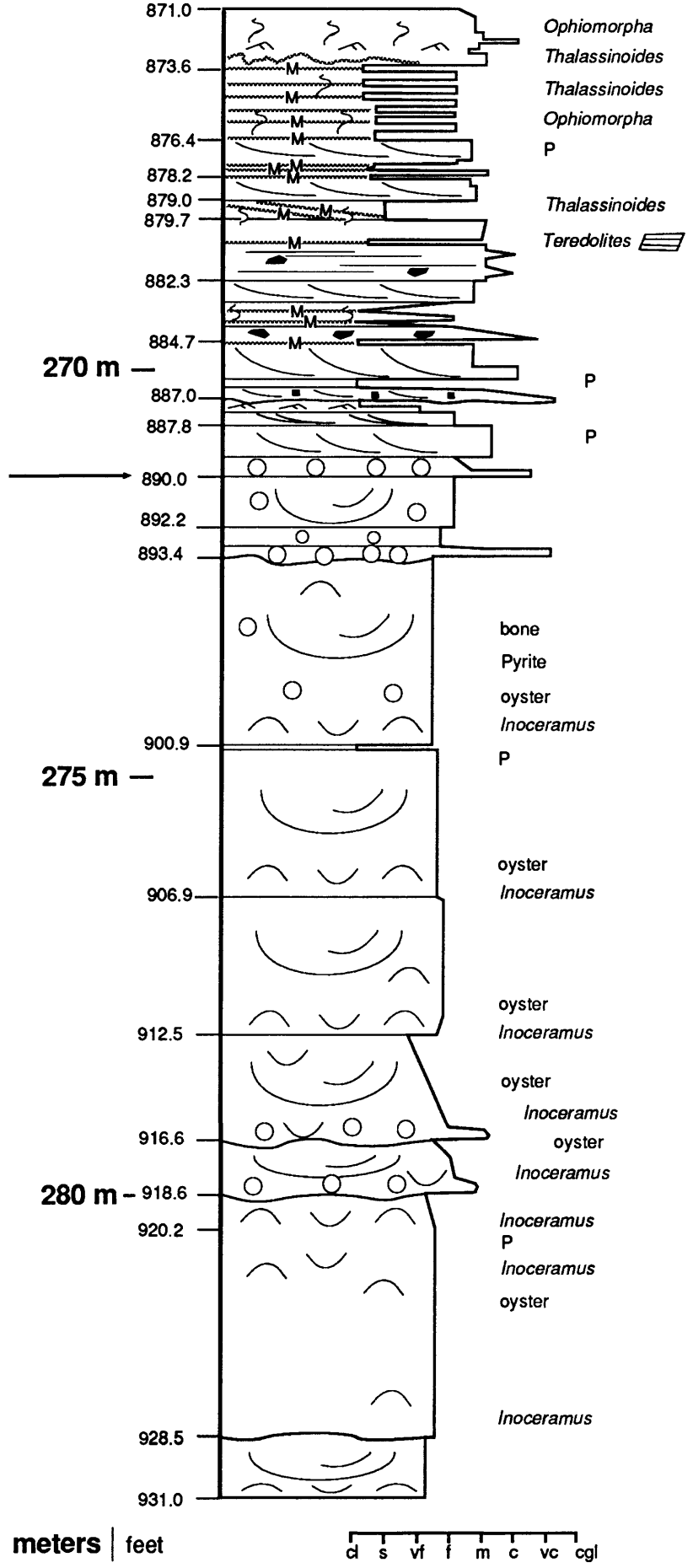
Tidal

Floodplain

Tidal

CT-1-91
(continued)

Down hole depth:
265.5 to 283.8 m
(871.0 to 931.0 ft)



Base of A-sandstone transgressive systems tract

A- sequence boundary

Top of Calico highstand systems tract

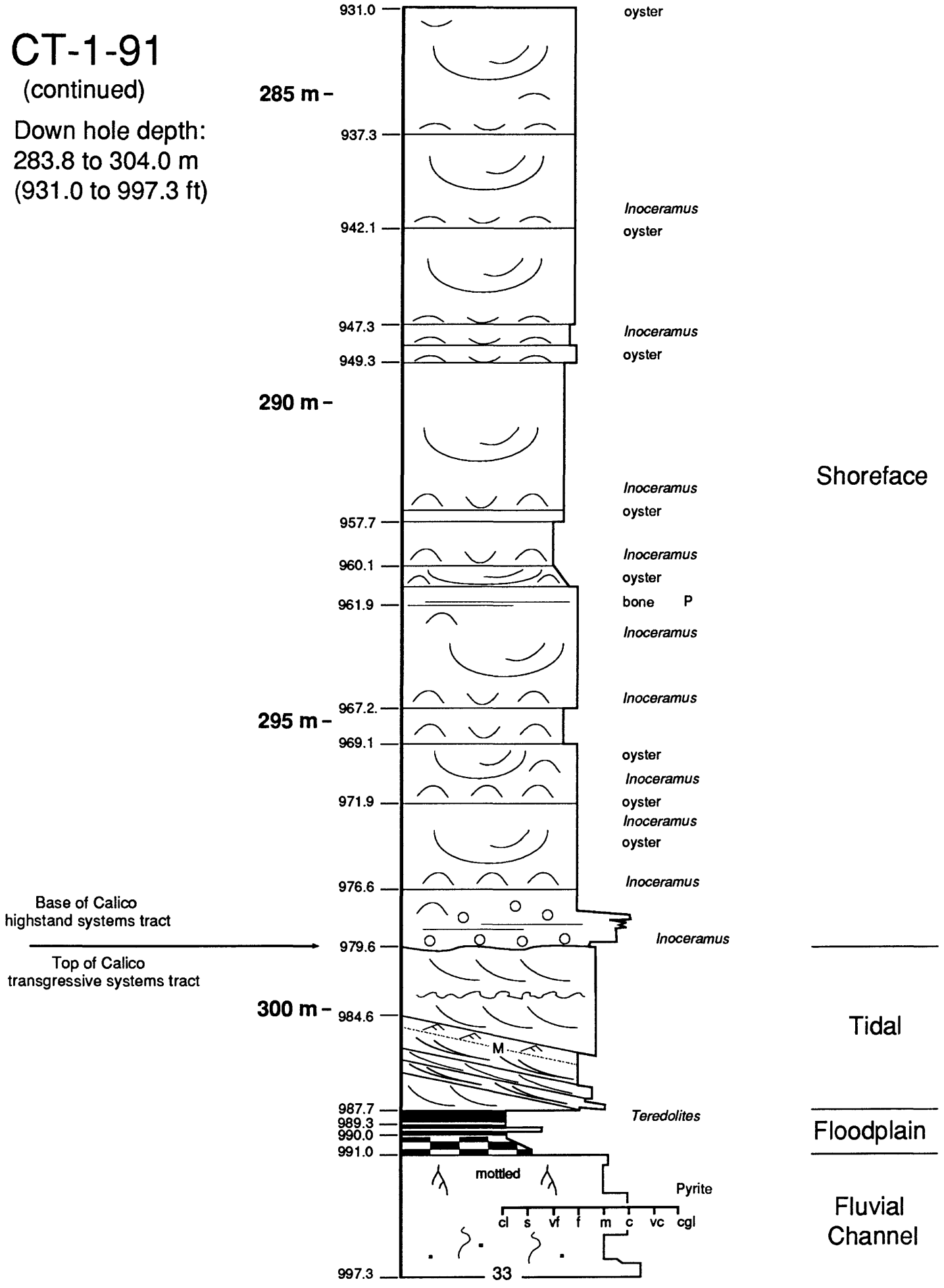
Tidal

Shoreface

CT-1-91

(continued)

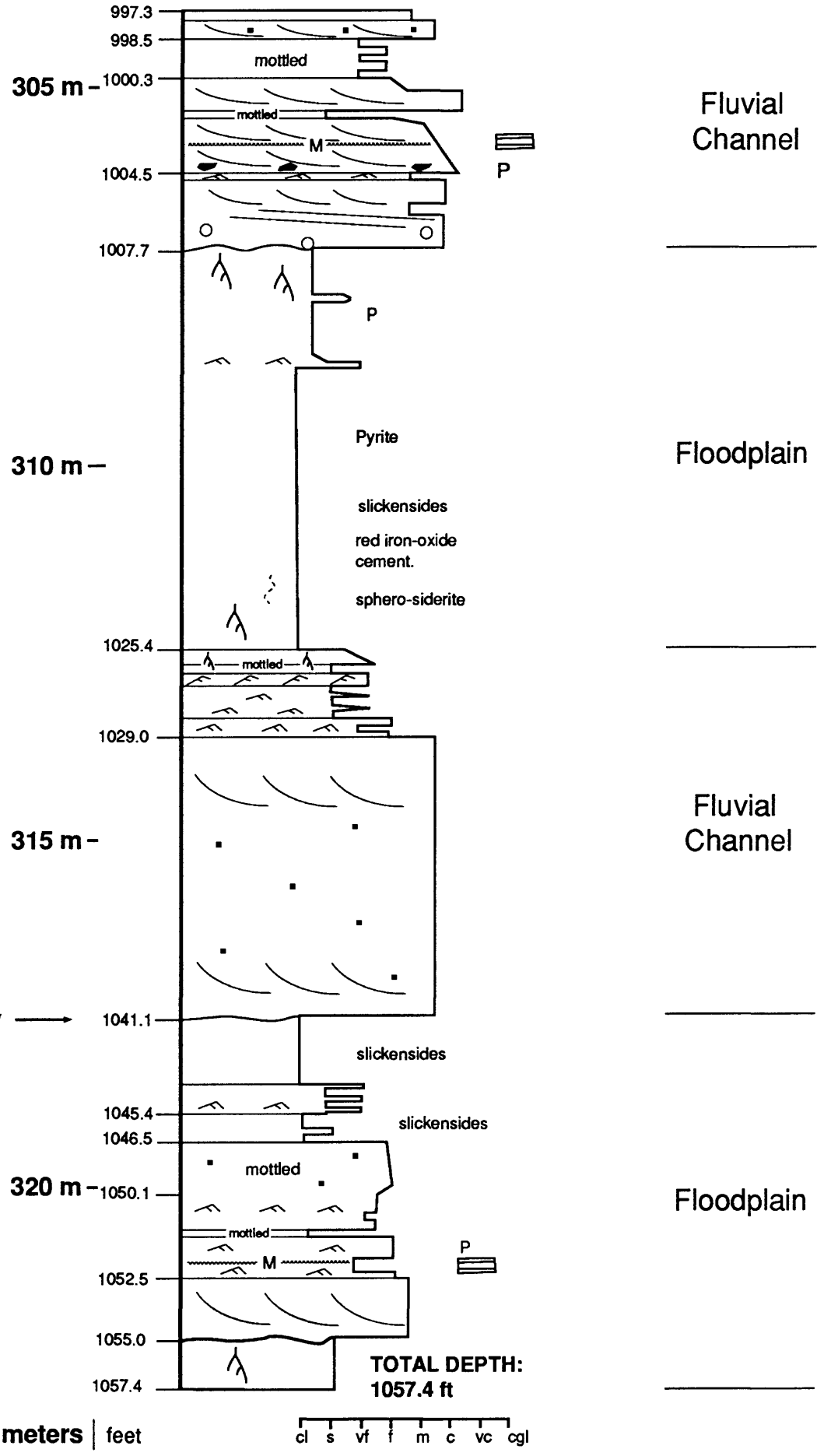
Down hole depth:
283.8 to 304.0 m
(931.0 to 997.3 ft)



CT-1-91

(continued)

Down hole depth:
304.0 to 322.3 m
(997.3 to 1057.4 ft)

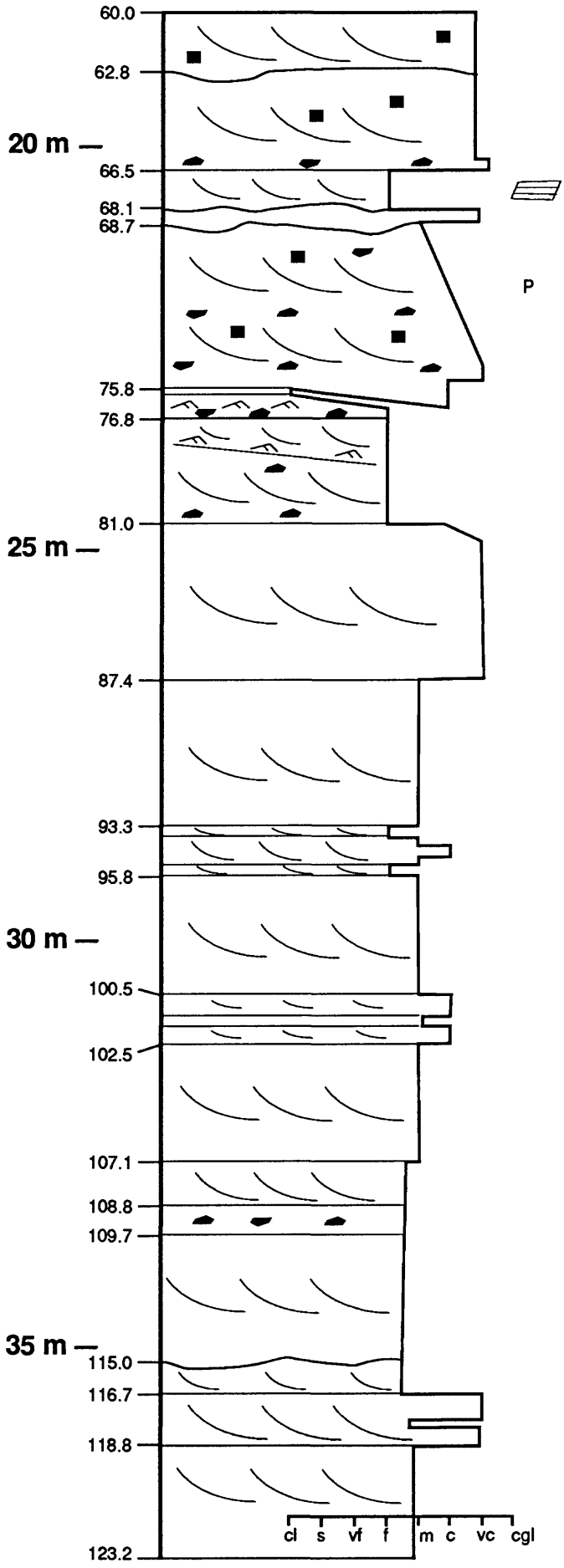


DETAILED DESCRIPTIONS AND PRELIMINARY INTERPRETATIONS FOR CORE SMP-1-91

(symbols are explained on p. 10)

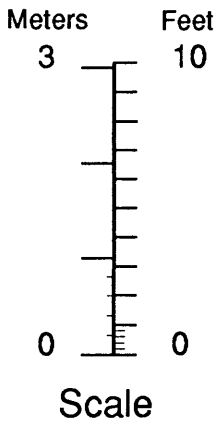
SMP-1-91

Down hole depth:
18.3 to 37.5 m
(60.0 to 123.2 ft)



Fluvial Channel

Fluvial Channel

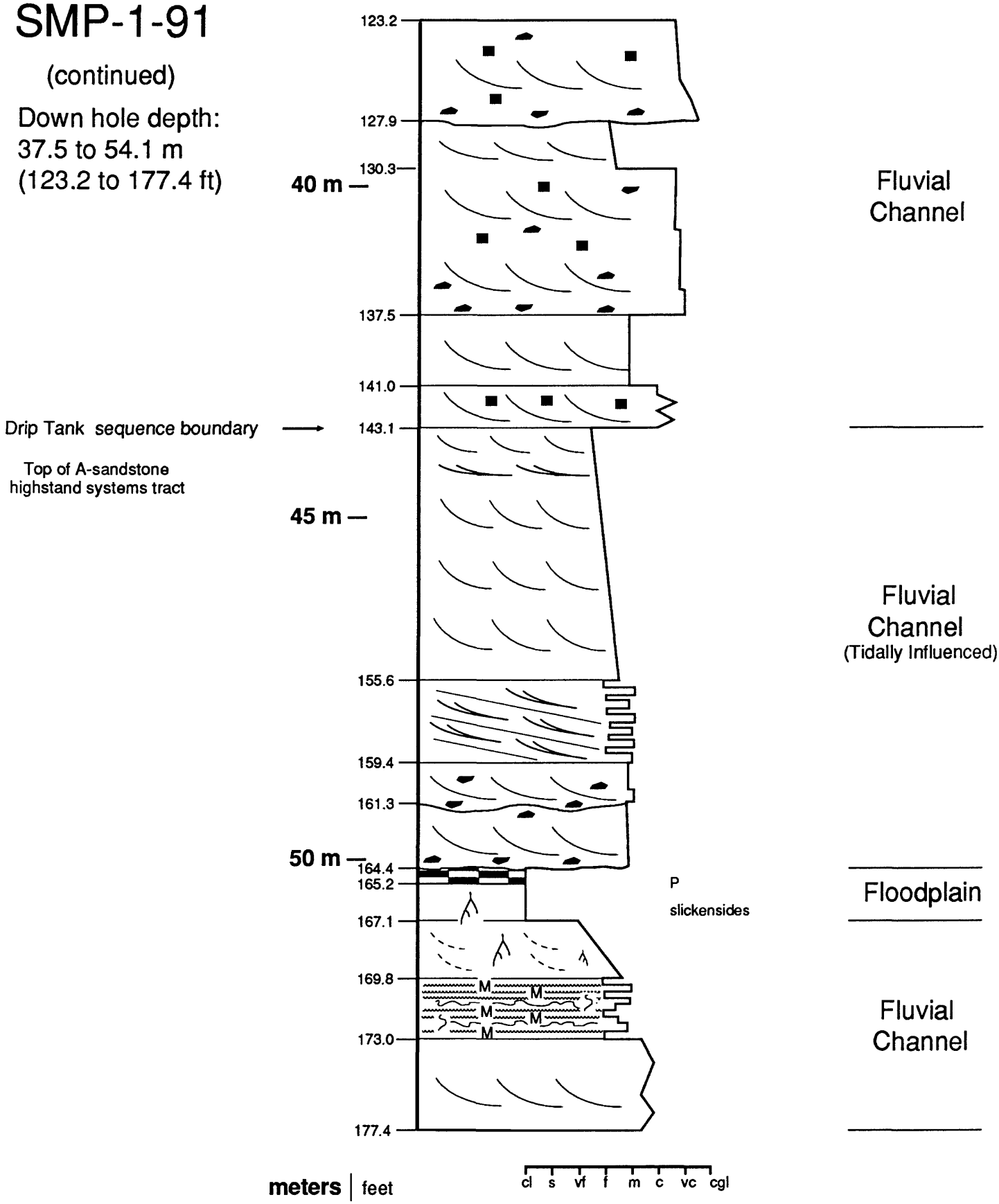


meters | feet

SMP-1-91

(continued)

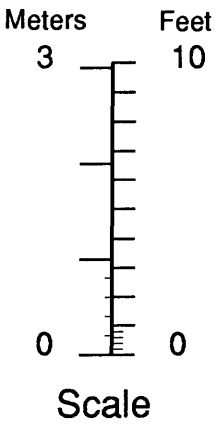
Down hole depth:
37.5 to 54.1 m
(123.2 to 177.4 ft)

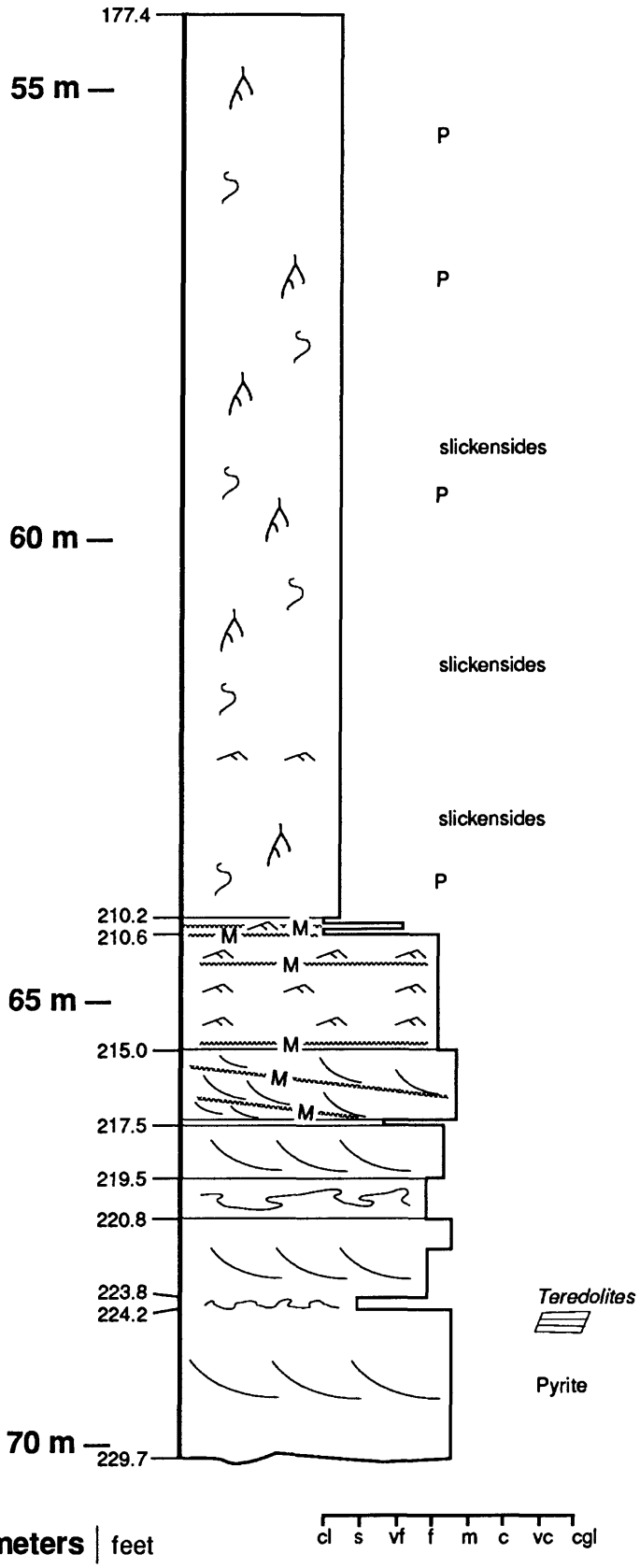


SMP-1-91

(continued)

Down hole depth:
54.1 to 70.1 m
(177.4 to 229.7 ft)





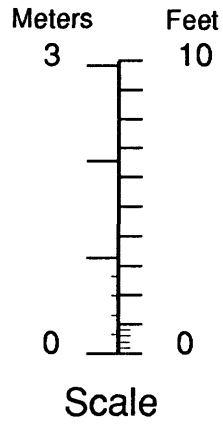
Floodplain

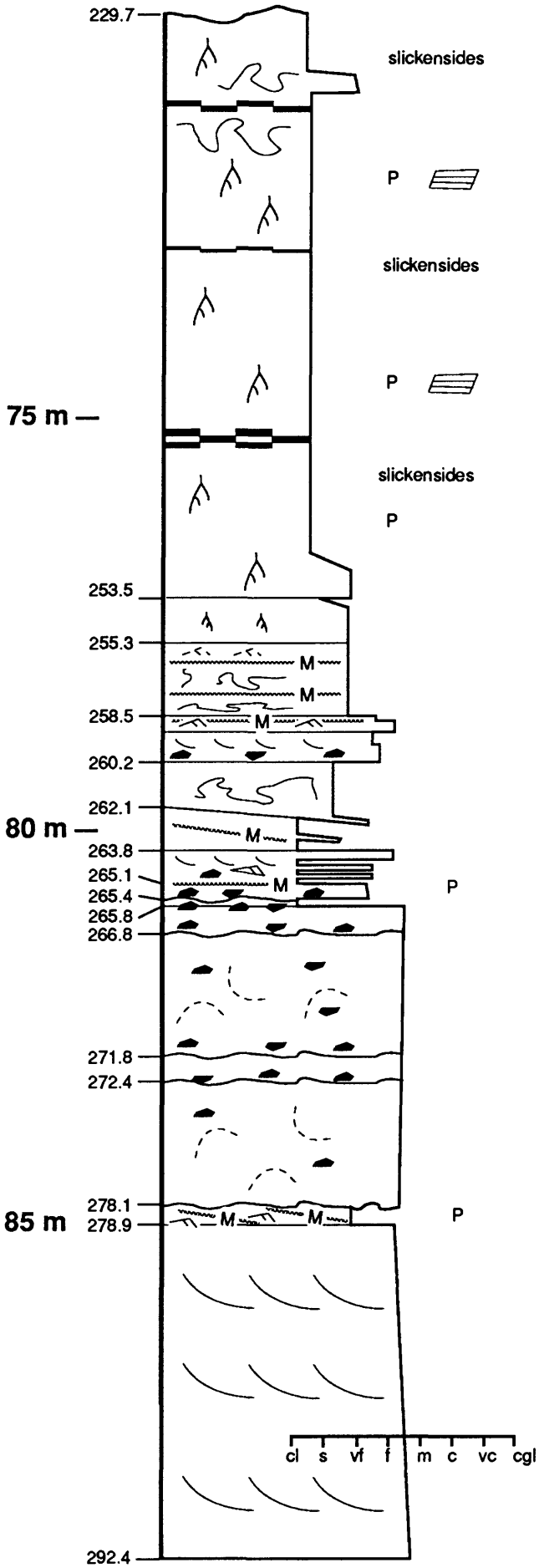
Fluvial Channel
(Tidally Influenced)

SMP-1-91

(continued)

Down hole depth:
70.1 to 89.1 m
(229.7 to 292.4 ft)





Floodplain

Tidal

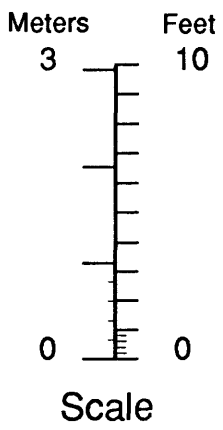
Fluvial Channel (Tidally Influenced)

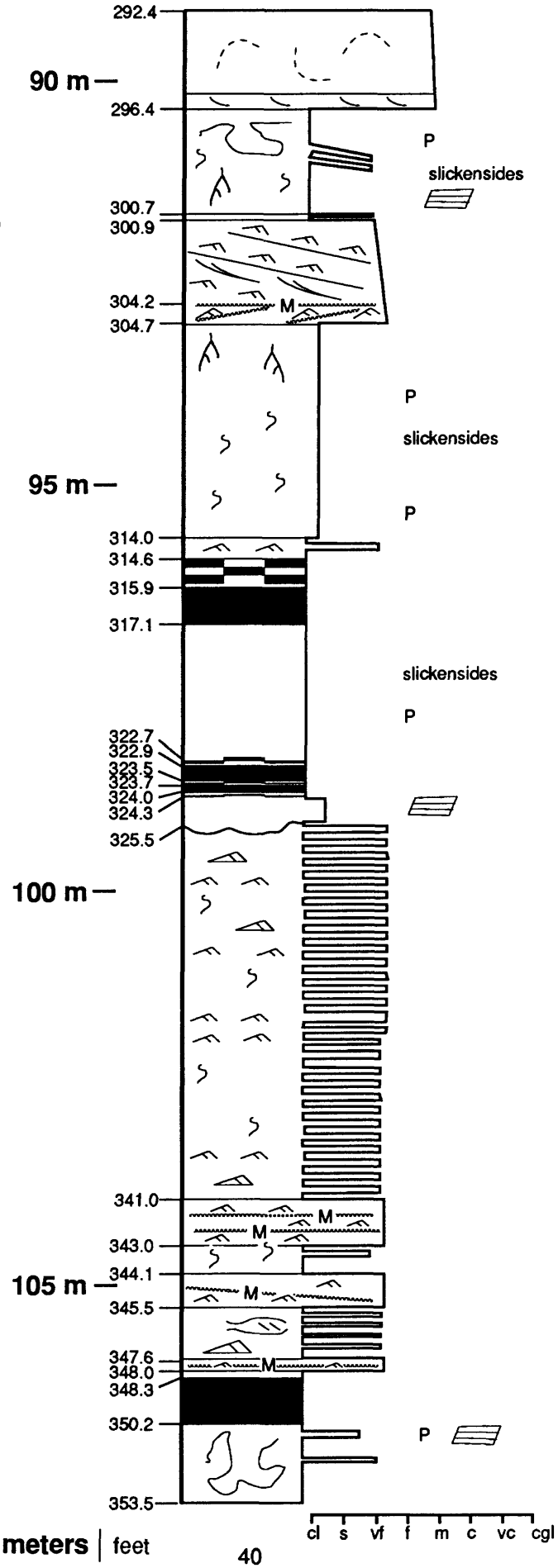
Fluvial Channel

SMP-1-91

(continued)

Down hole depth:
89.1 to 107. 7 m
(292.4 to 353.5 ft)





Fluvial Channel (Tidally Influenced)

Floodplain

Tidal

Floodplain

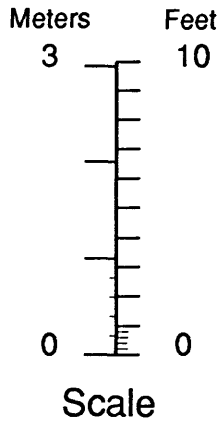
Tidal

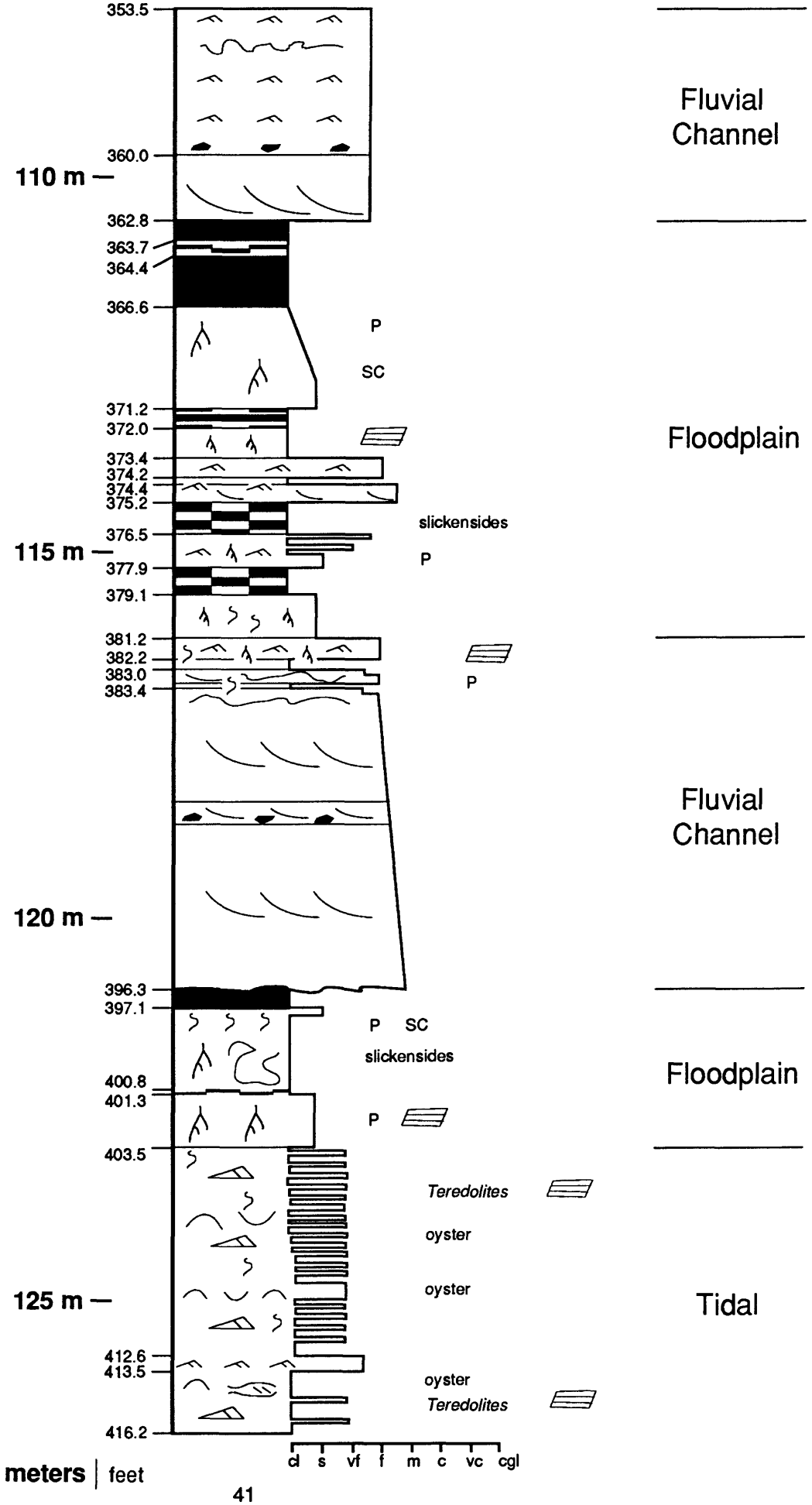
Floodplain

SMP-1-91

(continued)

Down hole depth:
107.7 to 126.9 m
(353.5 to 416.2 ft)

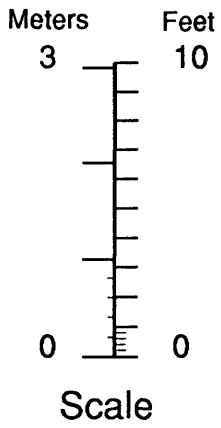


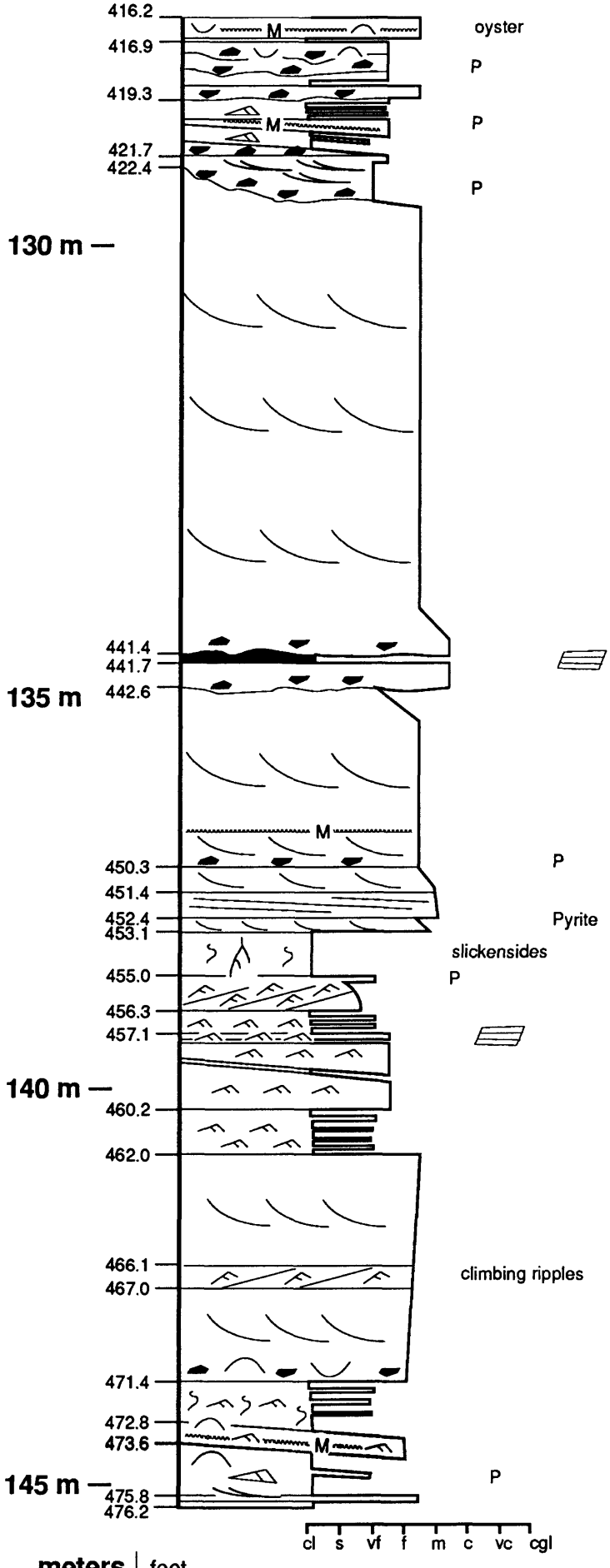


SMP-1-91

(continued)

Down hole depth:
126.9 to 145.1 m
(416.2 to 476.2 ft)





Tidal

Fluvial Channel

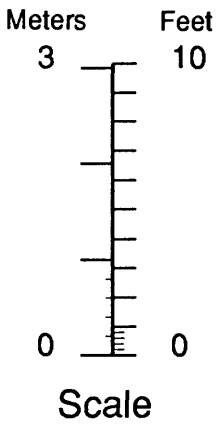
Floodplain

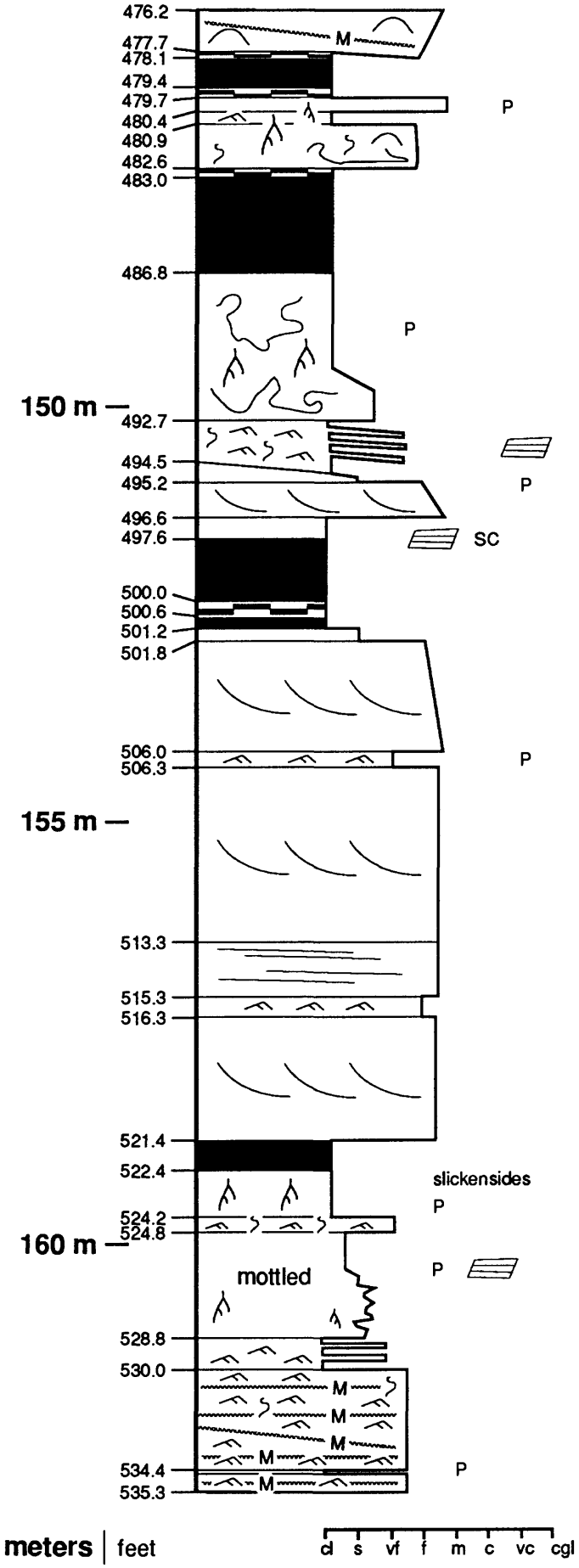
Tidal

SMP-1-91

(continued)

Down hole depth:
145.1 to 163.2 m
(476.2 to 535.3 ft)





Tidal

Floodplain

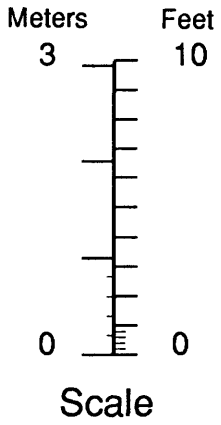
Fluvial Channel

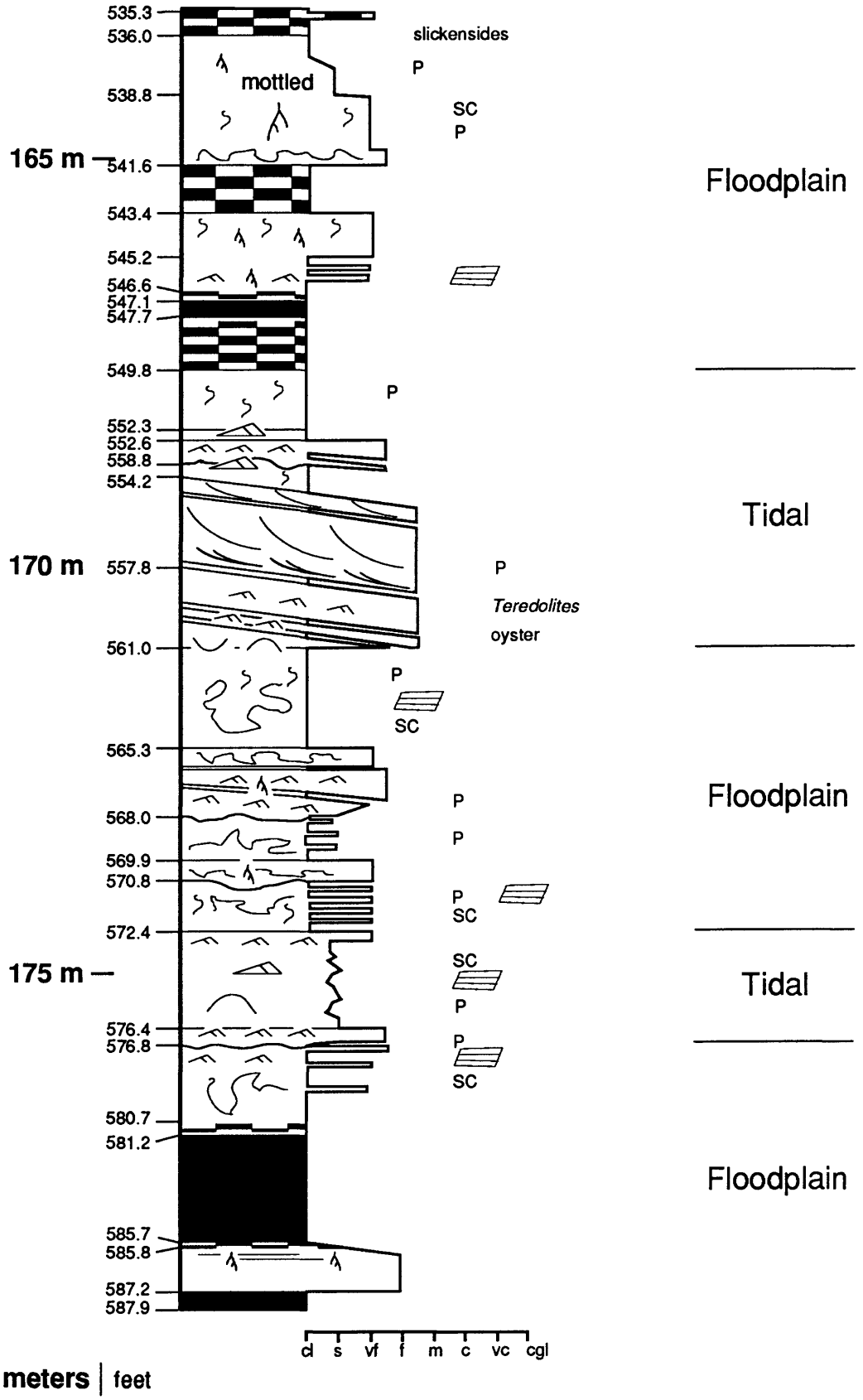
Floodplain

SMP-1-91

(continued)

Down hole depth:
163.2 to 179.2 m
(535.3 to 587.9 ft)

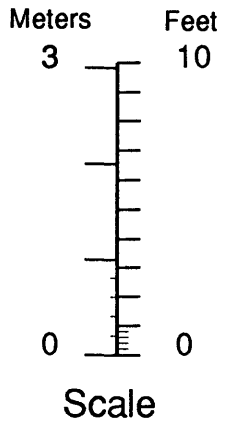


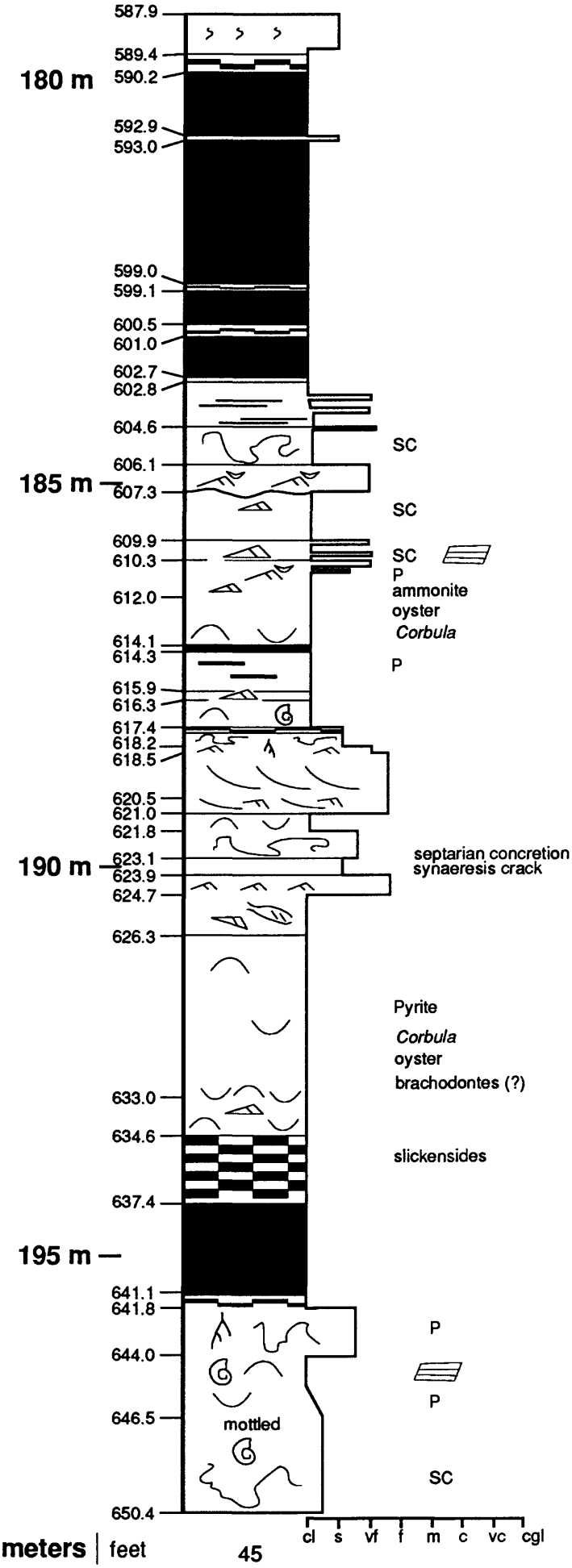


SMP-1-91

(continued)

Down hole depth:
179.2 to 198.2 m
(587.9 to 650.4 ft)





Floodplain

Tidal

Floodplain

Tidal

Floodplain

Tidal

Floodplain

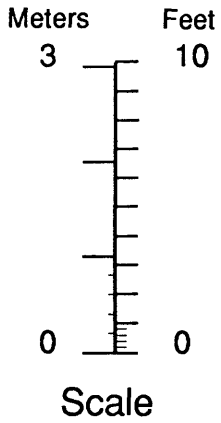
Tidal (?)

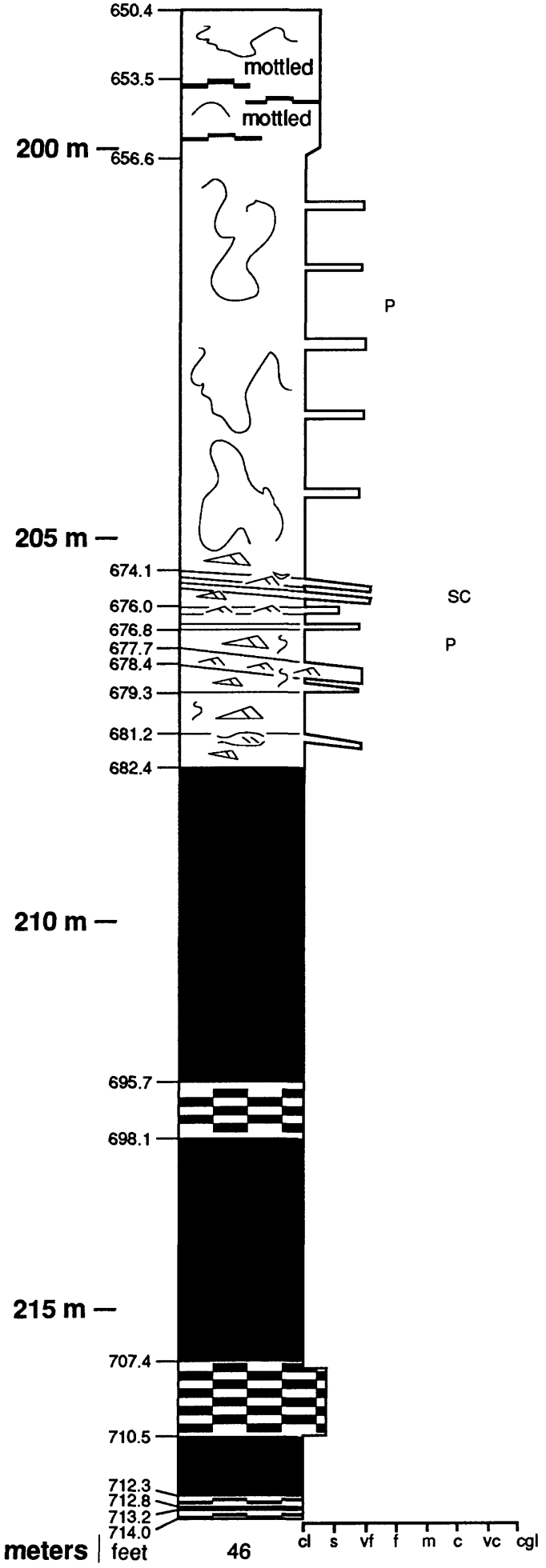
Floodplain

SMP-1-91

(continued)

Down hole depth:
198.2 to 217.6 m
(650.4 to 714.0 ft)

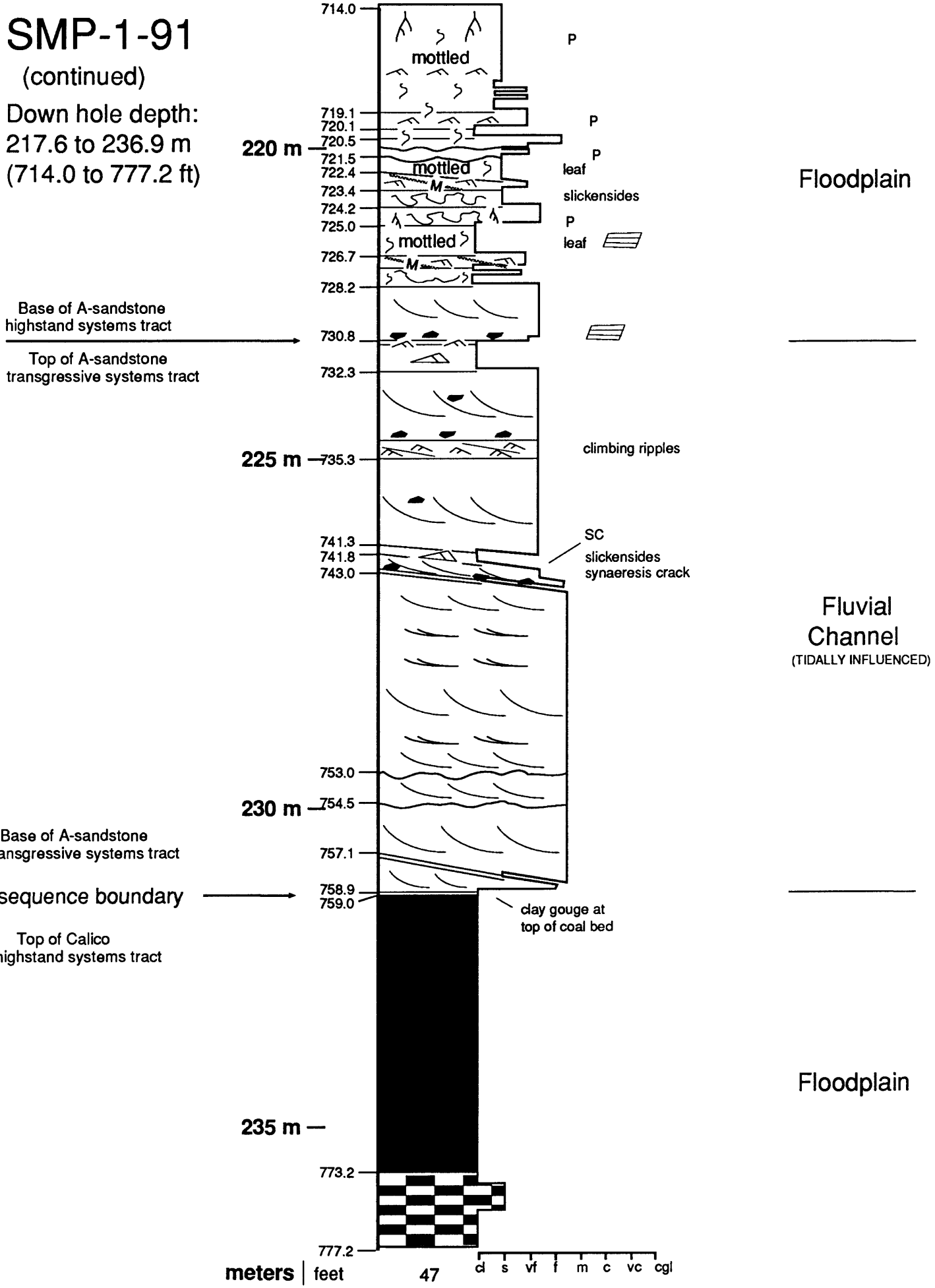




SMP-1-91

(continued)

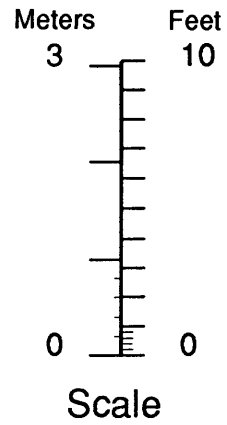
Down hole depth:
217.6 to 236.9 m
(714.0 to 777.2 ft)

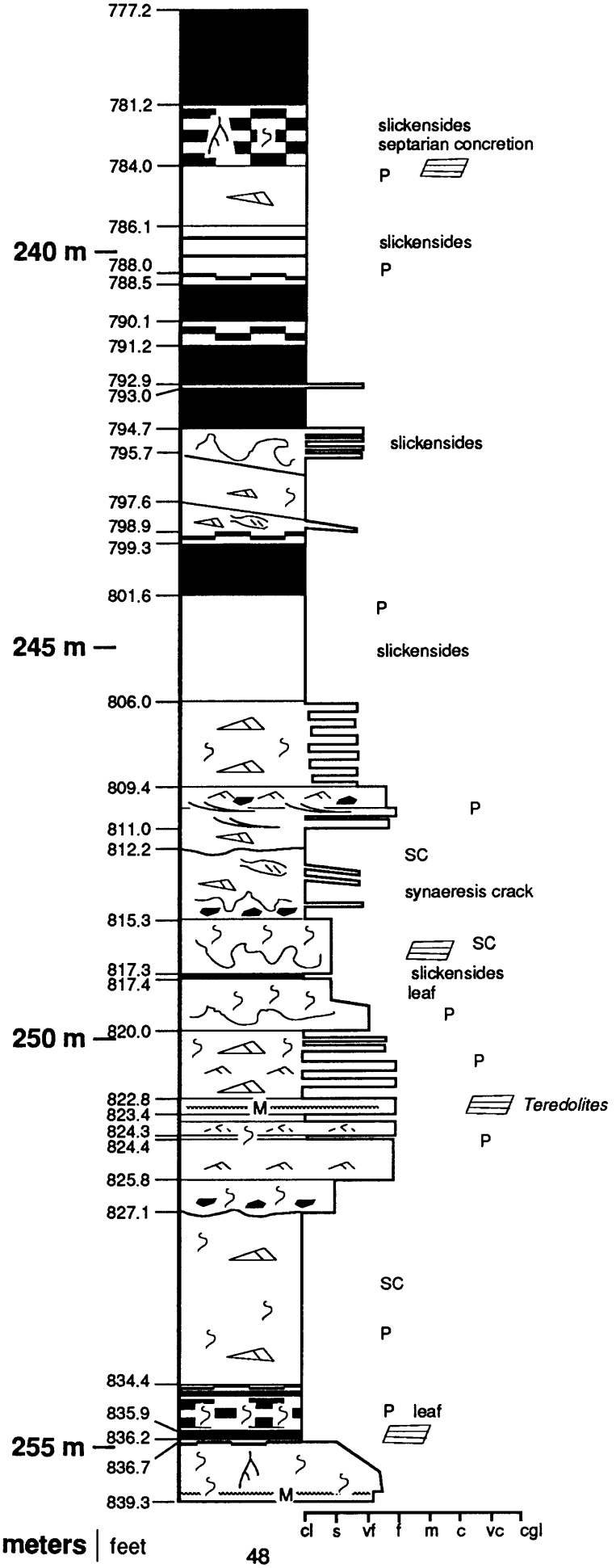


SMP-1-91

(continued)

Down hole depth:
236.9 to 255.8 m
(777.2 to 839.3 ft)

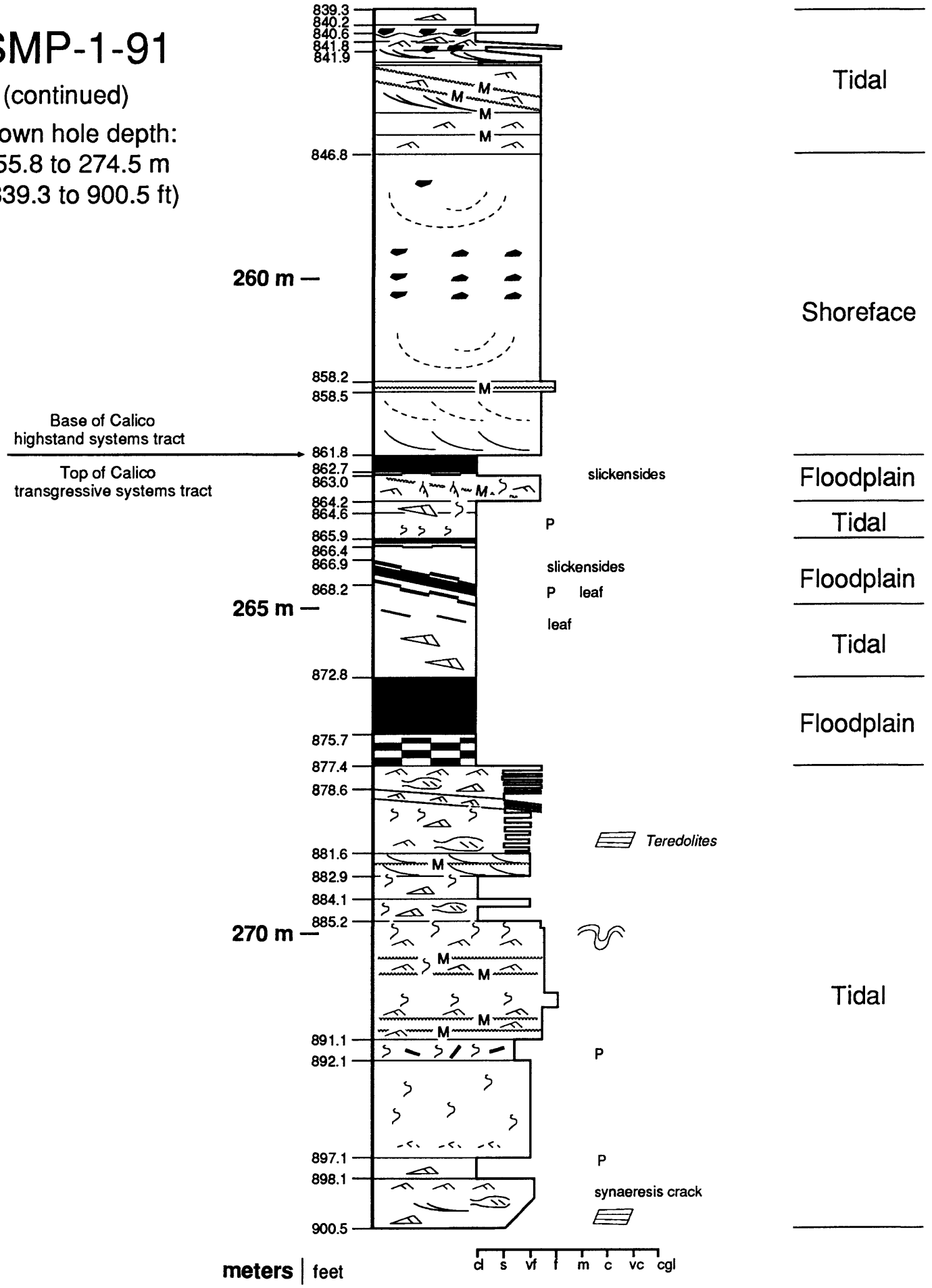




SMP-1-91

(continued)

Down hole depth:
255.8 to 274.5 m
(839.3 to 900.5 ft)



SMP-1-91

(continued)
Down hole depth:
274.5 to 293.4 m
(900.5 to 962.7 ft)