U.S. DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

Measured Section of the Pennsylvanian Hermosa Group Near Hermosa, Colorado

by

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Introduction

A comphrehensive study of the Paradox Basin is being conducted from 1989-1994 under the U.S. Geological Survey's Evolution of Sedimentary Basins Program. As part of the investigation of the Pennsylvanian System in the Paradox Basin, a detailed study of the Pennsylvanian Hermosa Group at Hermosa Mountain (about 20 km (12 mi) north of Durango, Colorado) on the west side of the Animas River Valley was undertaken. The objectives of this study were to establish better correlations between Pennslyvanian strata along the eastern basin margin and central basin area and between the Hermosa Mountain outcrops and those to the north in the San Juan Mountains area. A detailed sedimentologic interpretation of the Hermosa Mountain section provides a better understanding of the depositional processes operative along the active margin of the Paradox Basin.

For nearly a century, Pennslyvanian outcrops along the Animas River Valley have been an object of study. Spencer (in Cross and Spencer, 1899-1900, p. 48) first applied the name Hermosa Formation to these rocks. Although no type section was designated, Spencer derived the name from Hermosa Creek in the area where it enters the Animas River. Roth (1934) measured a section of the Hermosa, which he designated the type section, in secs. 26 and 35, T. 37 N., R. 9 W. (just north of the confluence of Hermosa Creek and the Animas River). Later, Bass (1944) provided a diagram of his Hermosa measured section from the same area and correlated this section to other Pennsylvanian outcrop and subsurface sections in the Four Corners area. Wengerd and Strickland (1954) presented data from a section they measured at Hermosa Mountain. Later, Wengerd and Matheny (1958) presented the diagram of this section, and they proposed raising the Hermosa Formation to Group status that included, in assending order, the Pinkerton Trial Formation, the Paradox Formation, and the Honaker Trail Formation.

The exposure of the Hermosa Group at Hermosa Mountain is the southernmost exposure of Pennsylvanian strata on the eastern side of the Paradox Basin. To the west, Pennsylvanian strata are in the subsurface and crop out again in the canyons of the San Juan River, about 100 mi (160 km) west of Hermosa Mountain. The Hermosa Group undergoes abrupt and dramatic facies changes across the Paradox Basin. Along the eastern margin of the Paradox Basin, near the basin-margin Uncompahgre Uplift, interbedded clastic and carbonate lithologies compose the Hermosa Group. These lithologies grade abruptly westward into interbedded evaporite, carbonate, and minor clastic units that characterize the Hermosa of the central part of the basin. From the central to the southwestern part of the basin, the Hermosa Group grades into shelf carbonate deposits having locally abundant algal-mound buildups and minor clastic units.

The Pennsylvanian outcrops from Hermosa Mountain northward to Silverton show the facies characteristic of the eastern basin margin, whereas the outcrops in the canyons of the San Juan River show the facies characteristic of the southwestern shelf area. By using the abundant subsurface geophysical data obtained from numerous oil fields in the southern part of the the Paradox Basin, good correlations of Pennslyvanian strata between the southwestern shelf facies and the evaporite-bearing basin-center facies have been established. Correlation of the eastern basin-margin facies to the basin center facies is less well established because of the paucity of subsuface data along the eastern part of the basin. This detailed study of the Hermosa Mountain section will determine if the predominantly eustaticly controlled cycles that are recognized in Pennsylvanian strata throughout the rest of the Paradox Basin can be recongized along the southeastern margin of the basin.

This report presents the lithologic descriptions, macroscopic observations, and interpretations of depositional environments from the Hermosa Mountain measured section of the Hermosa Group. The format used here enables more detail to be shown than would be possible in a standard manuscript figure or appendix. Ongoing studies of clastic and carbonate petrography and of brachiopod assemblages from this measured section will be compiled with the lithologic and sedimentologic data into a large plate that will be published in the USGS Miscellaneous Investigations Series.

Methods

The Hermosa Mountain measured section (fig. 2) is comprised of six segments located within sections 24, 25, 26, 35, and 36, T. 37 N., R. 9 W., in the Hermosa 7.5 minute quadrangle map (La Plata County, Colorado). Hermosa Mountian (not designated on the quadrangle map) is the local name of the cliff-forming highlands due north of the small town of Hermosa, Colorado. Vegetated to densely vegetated slopes characterize most of the Hermosa Mountain area. The location of each segment was chosen based on the quality of exposure and the presence of a traceable bed to offset to the next segment. With the exception of segment B, all segments are located in gullies, which generally have the most complete exposures. The abundance of vegetation and slope-cover prohibits lateral tracing of most units.

The section was measured with a Jacobs staff and Abney level except for the thick, cliff-forming units where a tape was dropped from the top of the cliff. Carbonate units and coarser-grained sandstone units over 3 ft (1 m) thick generally form resistant outcrops. Claystone, siltstone, and fine-grained sandstone units generally weather to a slope. These units were trenched and then described. Field descriptions were recorded at a scale of 1 in. to 10 ft. These descriptions were simplified to the 1 in. to 20 ft scale presented in this report.

Regularly spaced samples of the sandstone units were taken throughout the section to document changes in mineralogy. Preliminary analysis of these samples indicates that feldspar abundance is low (< 5 percent) from the base of the section to about 168 m (550 ft), above which it increases dramatically and may compose as much as 30 percent of the sandstone (Franczyk and others, in press).

Nearly every carbonate unit within the Hermosa Mountain section was sampled for slabbing and thin section analysis. Ongoing study of the carbonate samples is determining the faunal assemblages and abundances. The faunal types shown in the accessories column of figure 4 is based on macroscopic field observations and will be expanded with the final analysis of these carbonate samples.

Samples of dark-gray claystone, mudstone, and shale throughout the section were also collected for organic geochemistry and palynomorph analysis. Palynomorphs were sparce from these outcrop samples, and only long-ranging Pennsylvanian species were recovered (R.M. Kosanke, USGS, Denver, oral commun., 1992).

Figure 4 shows the measured section data, and figure 3 provides the explanation. The measured section shown in figure 4 covers 22 pages. Part or all of the unit at the top of each page is repeated at the base of the succeeding page to facilitate splicing the section into a continuous vertical column. The profile on the left side of the lithology column shows the grain size for clastic units. The lithologic profile for carbonate units is arbitrarily extended to the medium-grained interval; the texture of the carbonate unit is shown in the carbonate fabric column. An interpretation of depositional environments for units or packages of units is listed on the far left side of figure 4. Based on the interpreted environments, a relative sea level curve was constructed. Marine carbonate units are considered to represent the highest relative sea level and alluvial units the lowest. Marine deltaic and delta plain units are transitional between the two end members. Abrupt changes from high or intermediate relative sea level to low may correspond to a period of base level drop and subaerial exposure.

Geologic notes

Based on changes in the characteristics of carbonate units, the Hermosa Group at Hermosa Mountain can be divided into three parts: a 85-ft (26 m)-thick lower part (from

25-110 ft (8-34 m) in the section) characterized by fossiliferous limestone and rare dolomite and clastic units; a 1700-ft (518 m)-thick middle part (from 110-1810 ft (34-552 m) in the section) characterized by clastic units interbedded with thin, partly to extensively dolomitized, nonfossiliferous carbonate beds; and a 955-ft (291 m)-thick upper part (from 1810-2765 ft (552-843 m) in the section) characterized by clastic units interbedded with thick to thin fossiliferous limestone beds.

The lower part is equivalent to the Pinkerton Trail Formation of the Hermosa Group, a unit that is recognized at this stratigraphic horizon throughout much of the Paradox Basin. In the Hermosa Mountain area, the Pinkerton Trail is generally covered or only partially exposed. Segment A is at the best local exposure of the Pinkerton Trail and is in the area where Wengerd and Strickland (1954) first named and described this unit at the surface. At segment A, a 25 ft (8 m) thick covered section immediately overlies the Mississippian Leadville Limestone. Throughout most of the Paradox Basin the red, fine-grained Pennsylvanian Molas Formation of highly variable thickness lies between the Leadville and the Pinkerton Trail. At segment A there is no evidence of red material in the slope-covered interval between the Leadville and the lowest exposed carbonate bed of the Pinkerton Trial. The Molas is probably thin to absent in the Hermosa Mountain area. The covered intervals within the Pinkerton Trail may be fine-grained clastic units. Locally carbonaceous shale and scattered coally material is between the carbonate units, but there is no definitive evidence at this location of subaerial exposure within the Pinkerton Trail. The upper contact of the Pinkerton Trail is not exposed in the Hermosa Mountain area. A few miles to the north, a road cut through the upper part of the Pinkerton Trial shows a sandstone-dominated interval sharply overlying the carbonate unit at the top of the Pinkerton Trail.

Because the upper contact of the Pinkerton Trail is not exposed in the Hermosa Mountain area, the base of segment B was begun at the top of the Leadville Limestone. A covered interval 220 ft (67 m) thick is between the top of the Leadville and the well exposed units of the Hermosa Group. The basal 110 ft (33.5 m) of the covered interval is equivalent to the Pinkerton Trial, and the remaining 110 ft (33.5 m) of this interval is probably similar to the lithologies that are throughout segment B: dominantly clastic units and minor thin carbonate beds.

The middle part and approximately the lower 200 ft (61 m) of the upper part of the Hermosa Group at Hermosa Mountain are equivalent to the evaporite-bearing Paradox Formation in the central part of the Paradox Basin. In this Hermosa Mountain section, I have not subdivided the Hermosa Group above the Pinkerton Trail because at this time the exact position of the contact between the Paradox and Honaker Trail Formations is uncertain. There are about 100 ft (30 m) of gypsum interbedded with a minor amount of shale starting at about 1320 ft (402 m) in the measured section. The gypsum pinches out to the north, but the exact location of the pinchout is unknown because of extensive cover in this part of the Hermosa along the length of the Hermosa Cliffs. The thickness and stratigraphic position of the gypsum interval suggests that it correlates with cycle 6 of Hite's (1961) evaporite sequence in the central part of the Paradox Basin.

The upper 765 ft (233 m) of the upper part of the Hermosa Group at Hermosa Mountain correlates to part of the Honaker Trail Formation in the central part of the Paradox Basin. The Hermosa at Hermosa Mountain has a gradational contact with the overlying alluvial red beds of the Cutler Formation, and the top of the Hermosa is placed at the top of the highest carbonate bed of probable marine origin. The only carbonate material observed in the Cutler is of pedogenic origin.

I have choosen not to apply the name Rico Formation at Hermosa Mountain because the entire Hermosa Group contains a significant amount of nonmarine clastic units. Because the Rico was defined as being a unit transitional between the Hermosa (which was interpreted to be entirely marine) and the Cutler (which was interpreted to be entirely nonmarine), it does not appear to be present in this section. There is no horizon in the

Hermosa Group in this area where interbedded marine clastic and carbonate units grade upwards into interbedded nonmarine clastic and marine carbonate units, which then grade into the nonmarine Cutler Formation.

North of Hermosa Mountain to Elbert Creek, the upper part of the Hermosa Group is well exposed, though inaccessible, along the Hermosa Cliffs. North of Elbert Creek, the Hermosa Group is generally well exposed along an outcrop belt that continues nearly to the Siverton area. Spoelhof (1974) did a thorough study of the Hermosa Group between Engineer Mountain and the Silverton area. He divided the Hermosa Group into two formations: the Pinkerton Trail Formation, which ranges in thickness from 0-275 ft (0-84 m), at the base overlain by the Honaker Trail Formation, which locally is as thick as 2800 ft (853 m). Spoelhof recognized three subdivisions within his Honaker Trail: a lower and upper clastic-dominated part separated by a middle carbonate-dominated part. This middle part is equivalent to a more carbonate-rich interval at the Hermosa Mountain section that extends from 1780 to 2220 ft (543 to 677 m).

Preliminary analysis of the brachiopod assemblages collected in the Pinkerton Trail Formation at Hermosa Mountain has identified a species that occurs in earliest Desmoinesian time, a species that could be either Atokan or Desmoinesian, and a species that spans latest Atokan to earliest Desmoinesian time. Based on the combined fusulinid and brachiopod assemblages, the Pinkerton Trail at Hermosa Mountain was probably deposited close to the Atokan-Desmoinesian boundary, most likely in earliest Desmoinesian time (Franczyk and others, in press). Brachiopod assemblages collected 165-295 ft (50-90 m) below the top of the Hermosa Group at Hermosa Mountain indicate a latest middle- to ealiest late-Desmoinesian age (Franczyk and others, in press). The basal part of the Cutler at Hermosa Mountain is inferred to be of late Desmoinesian age based on the age of the uppermost part of the Hermosa, the gradational contact with the overlying Cutler Formation, and the lack of fossils in the Cutler.

Paleocurrent measurements obtained primarily from trough cross-stratification within deltaic marine and nonmarine sandstones throughout the Hermosa Mountain measured section show dominantly southwesterly transport directions (fig. 2, samples and paleocurrent column). An average mean vector of 230° is calculated from all the measurements (140 readings) taken within the measured section (fig. 4). Rivers flowing southwesterly from a drainage basin in the adjacent Uncompahgre Uplift brought sediment to the alluvial and deltaic environments in the Hermosa Mountain area. Spoelhof (1974) recorded similar southwesterly paleocurrent measurements through the Hermosa Group in the Engineer Mountain to Silverton area. North of Silverton, the Pennslyvanian drainage appears to have shifted to a more westerly direction. The most northerly exposure of the Hermosa Group occurs in the Ouray area, about 40 km (25 mi) north of Silverton. An average mean vector of 281° is calculated from 78 measurements taken throughout the Hermosa Group in the Ouray area (Franczyk, unpub. data).

Acknowledgements

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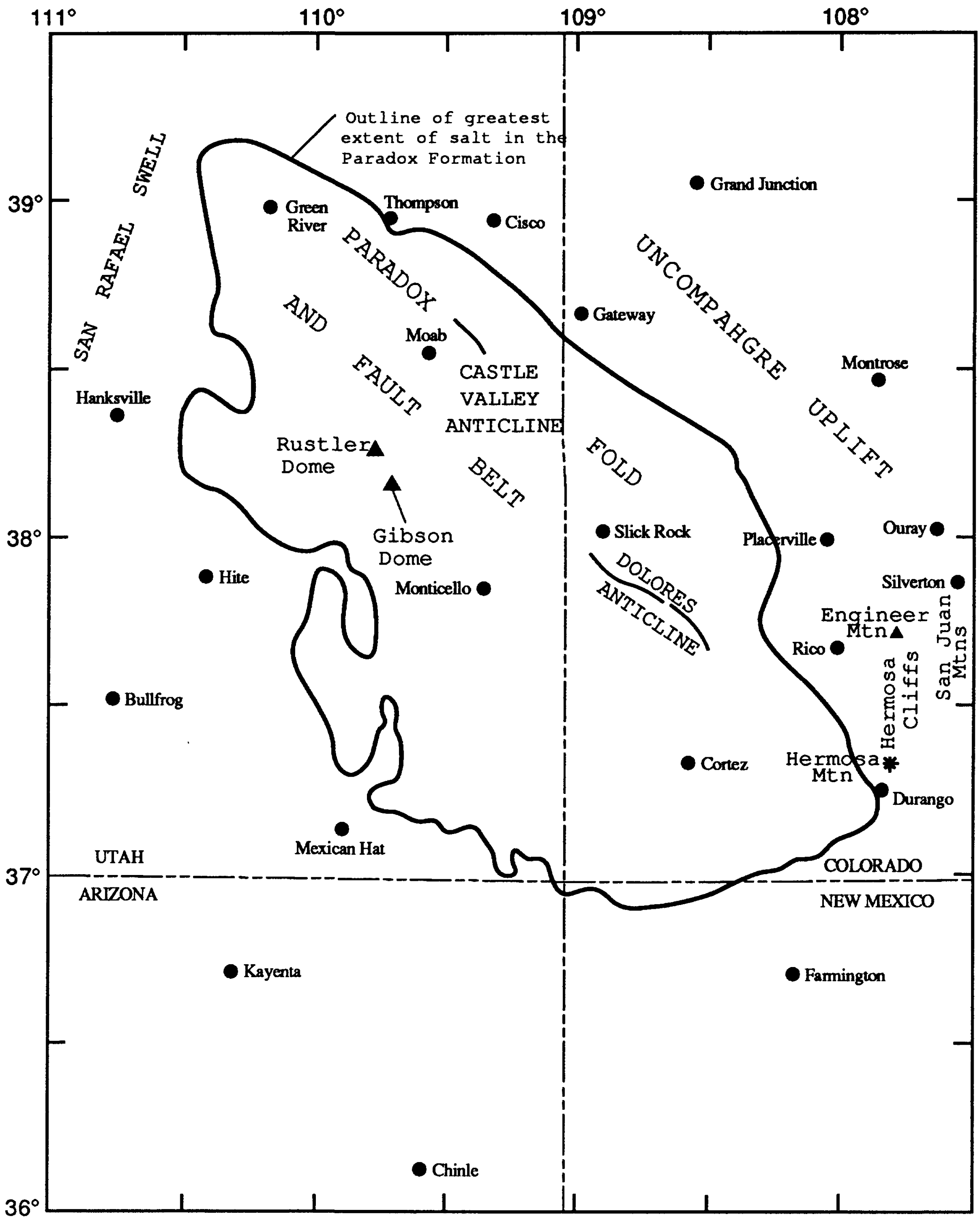


Figure 1. Location map showing the Paradox Basin, which here corresponds to the maximum extent of salt in the Paradox Formation, and surrounding geologic features. The star shows the location of the Hermosa Mountain measured section, which is slightly northeast of Durango, Colorado.

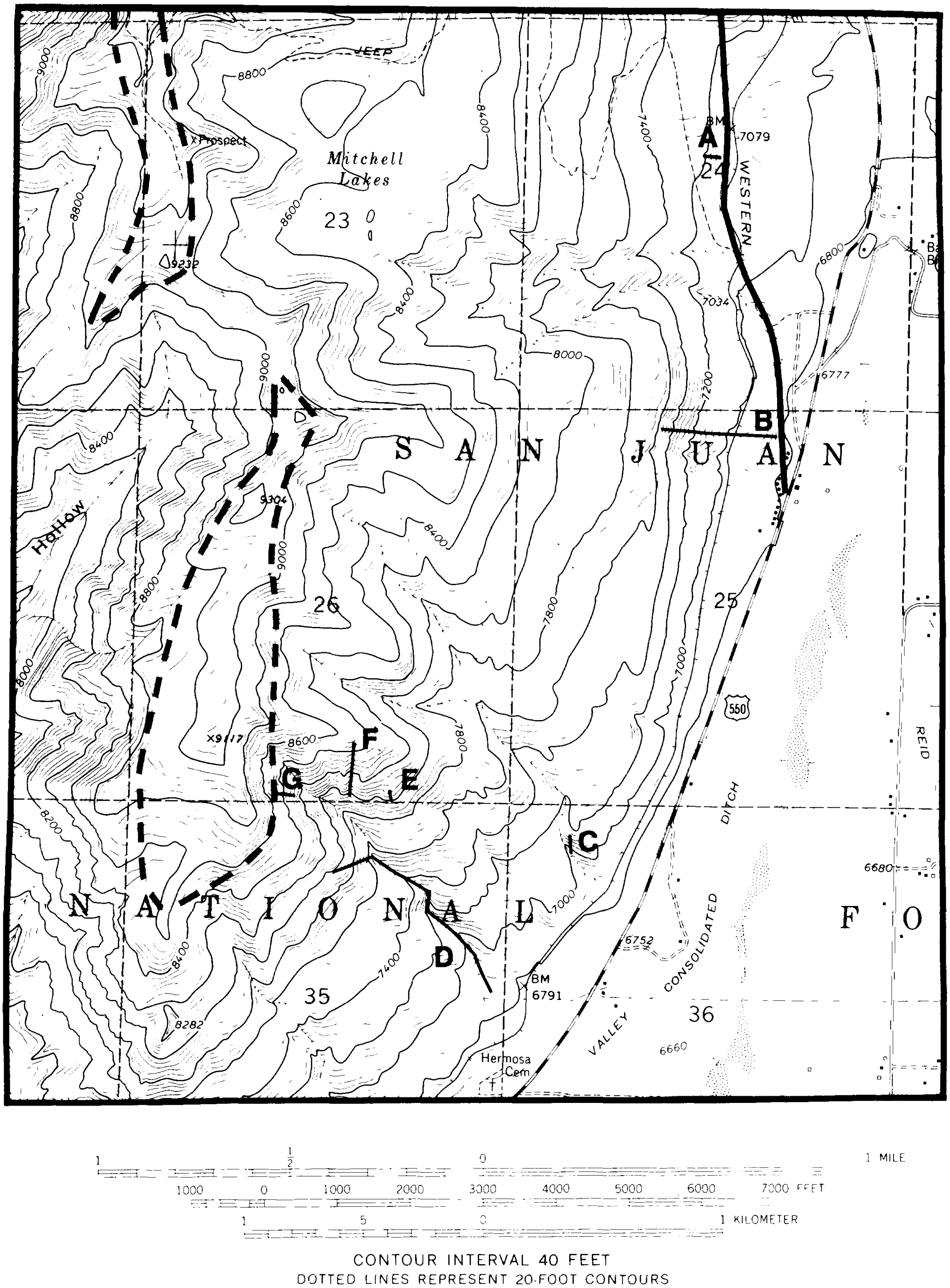
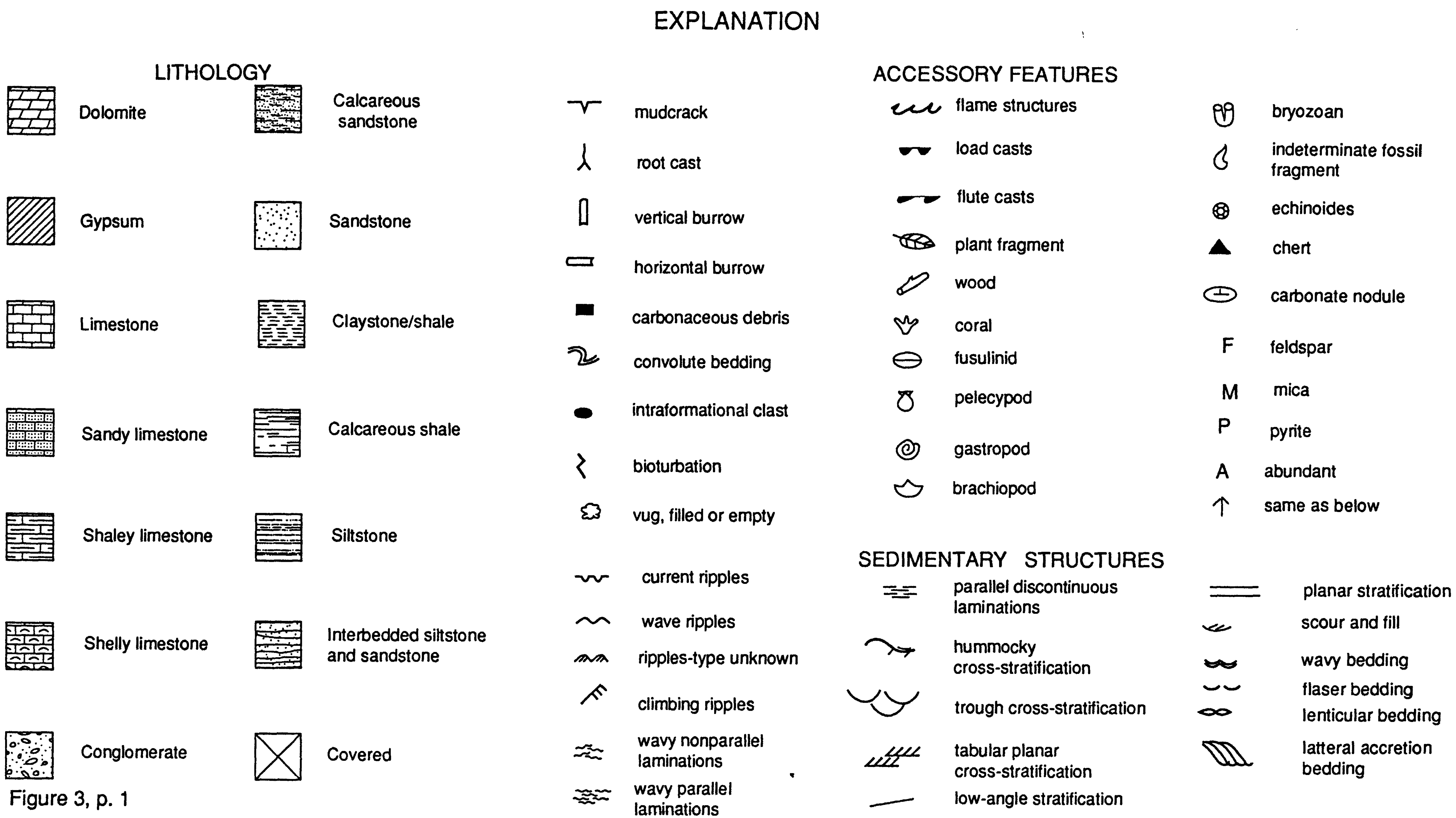


Figure 2. Location map of the Hermosa Mountain measured section. A, B, C, D, E, F, and G identify segments of the measured section that are indicated in the description in figure 4. The Hermosa Group lies between the Leadville Limestone (approximate top shown by the solid heavy line) and the Cutler Formation (appoximate base shown by dashed heavy line). Base from the Hermosa 7.5' topographic map.


EXPLANATION
LITHOLOGY
Dolomite
Calcareous sandstone
Gypsum
Sandstone
Limestone
Claystone/shale
Sandy limestone
Calcareous shale
Shaley limestone
Siltstone
Shelly limestone
Interbedded siltstone and sandstone
Conglomerate
Covered
mudcrack
root cast
vertical burrow
horizontal burrow
carbonaceous debris
convolute bedding
intraformational clast
bioturbation
vug, filled or empty
current ripples
wave ripples
ripples-type unknown
climbing ripples
wavy nonparallel laminations
wavy parallel laminations
ACCESSORY FEATURES
flame structures
load casts
flute casts
plant fragment
wood
coral
fusulinid
pelecypod
gastropod
brachiopod
bryozoan
indeterminate fossil fragment
echinoides
chert
carbonate nodule
F feldspar
M mica
P pyrite
A abundant
same as below
SEDIMENTARY STRUCTURES
parallel discontinuous laminations
hummocky cross-stratification
trough cross-stratification
tabular planar cross-stratification
low-angle stratification
planar stratification
scour and fill
wavy bedding
flaser bedding
lenticular bedding
latteral accretion bedding
Figure 3, p. 1

EXPLANATION

DEPOSITIONAL ENVIRONMENT

NM	Nonmarine
AL	Alluvial
DP	Delta plain
DF	Delta front
PD	Prodelta
T	Tidal
SM	Shallow marine
M	Marine
ME	Marine evaporite

CARBONATE FABRIC

M	Lime mudstone
W	Wackestone
P	Packstone
G	Grainstone
X	Crystalline

BEDDING THICKNESS

VTH	Very thin
TH	Thin
M	Medium
TK	Thick
VTK	Very thick

CONTACT TYPE

S	Sharp
SI	Sharp, irregular
G	Gradational
C	Covered

COLOR

B	Brown	Or	Orange	D	Dark
Bl	Black	Pk	Pink	L	Light
G	Gray	R	Red	M	Medium
Gr	Green	Y	Yellow	P	Pale
O	Olive				

Figure 3, p. 2

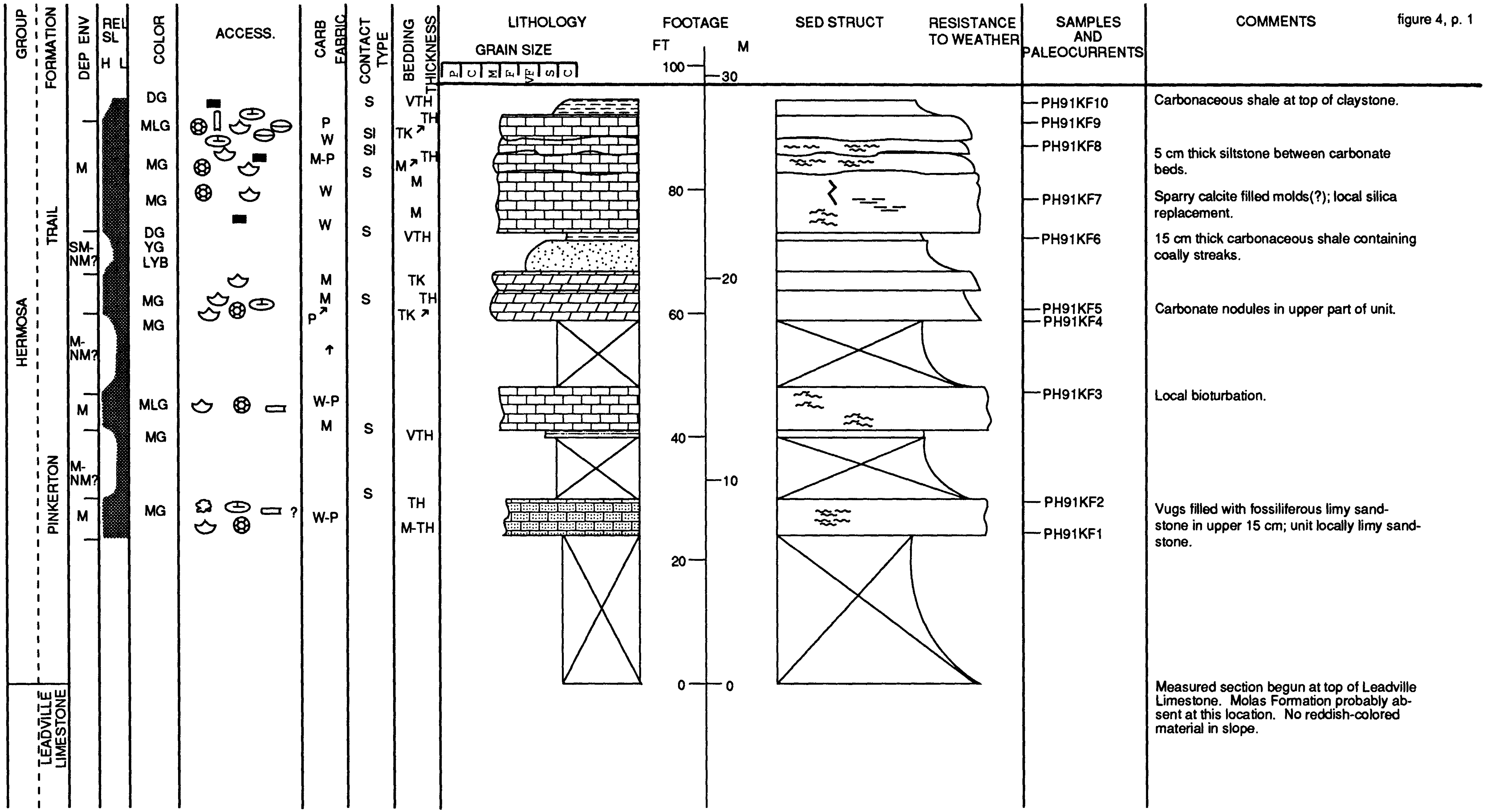


figure 4, p. 1
GROUP
FORMATION
DEP ENV
REL SL
H L
COLOR
ACCESS.
CARB FABRIC
CONTACT TYPE
BEDDING THICKNESS
LITHOLOGY
GRAIN SIZE
P C M F VF S C
FOOTAGE
FT
M
SED STRUCT
RESISTANCE TO WEATHER
SAMPLES AND PALEOCURRENTS
COMMENTS
HERMOSA
TRAIL
PINKERTON
LEADVILLE LIMESTONE
M
SM-NM?
M-NM?
M
M-NM?
M
DG
MLG
MG
MG
DG
YG
LYB
MG
MG
MLG
MG
MG
P
W
M-P
W
W
M
M
P
W-P
M
W-P
S
SI
SI
S
S
S
S
S
VTH
TH
TK
TH
M
M
M
VTH
TK
TH
TK
VTH
TH
M-TH
100
80
60
40
20
0
30
20
10
0
PH91KF10
PH91KF9
PH91KF8
PH91KF7
PH91KF6
PH91KF5
PH91KF4
PH91KF3
PH91KF2
PH91KF1
Carbonaceous shale at top of claystone.
5 cm thick siltstone between carbonate beds.
Sparry calcite filled molds(?); local silica replacement.
15 cm thick carbonaceous shale containing coally streaks.
Carbonate nodules in upper part of unit.
Local bioturbation.
Vugs filled with fossiliferous limy sandstone in upper 15 cm; unit locally limy sandstone.
Measured section begun at top of Leadville Limestone. Molas Formation probably absent at this location. No reddish-colored material in slope.

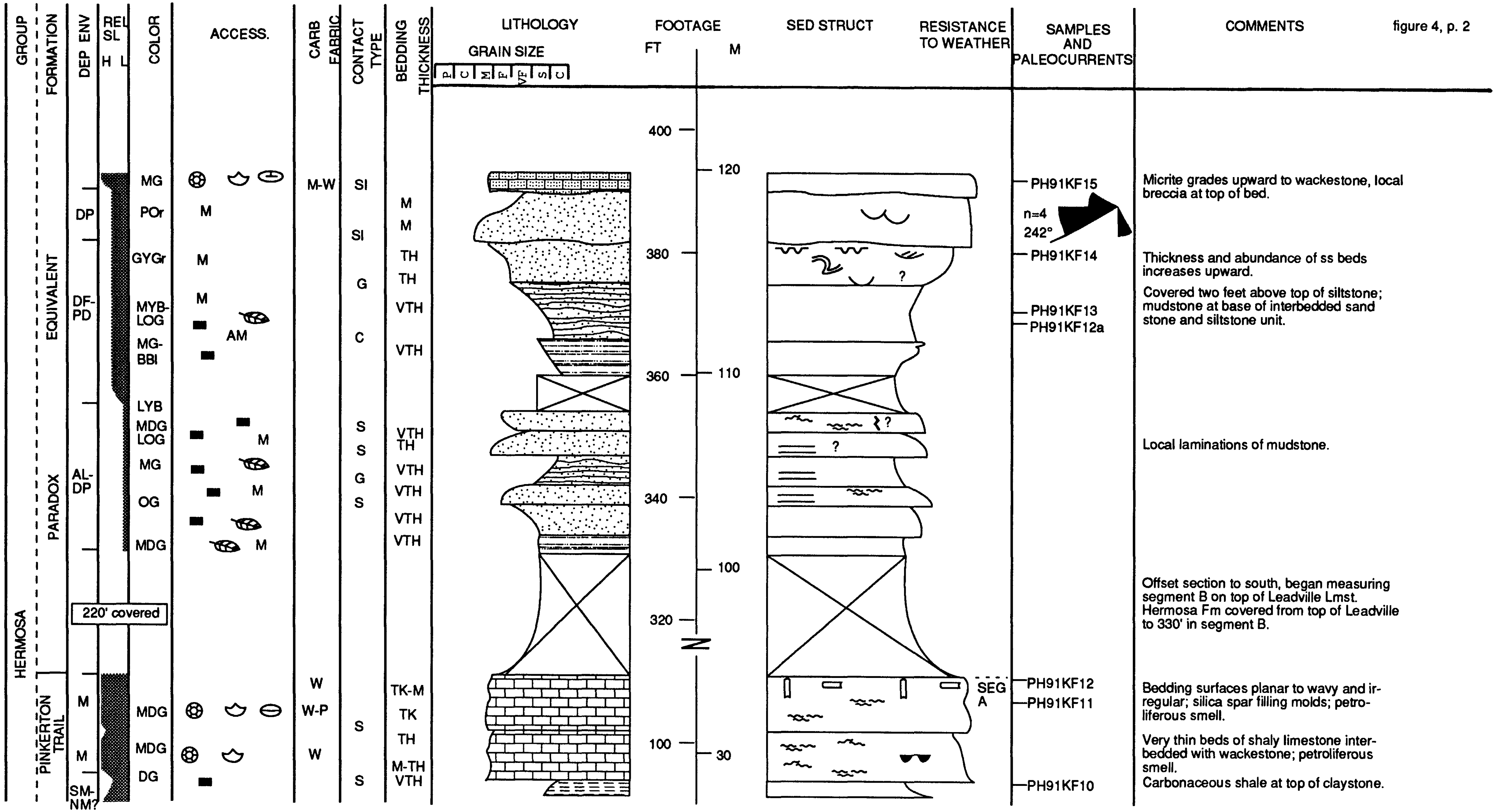

GROUP
FORMATION
DEP ENV
REL SL
H L
COLOR
ACCESS.
CARB FABRIC
CONTACT TYPE
BEDDING THICKNESS
LITHOLOGY
GRAIN SIZE
P C M F VF S C
FOOTAGE
FT
M
SED STRUCT
RESISTANCE TO WEATHER
SAMPLES AND PALEOCURRENTS
COMMENTS
HERMOSA
PINKERTON TRAIL
PARADOX
EQUIVALENT
DP
DF-PD
AL-DP
M
M
SM-NM?
220' covered
MG
POr
GYGr
MYB-LOG
MG-BBI
LYB
MDG
LOG
MG
OG
MDG
MDG
MDG
DG
M
M
M
AM
M
M
M
M
M-W
W
W-P
W
SI
SI
G
C
S
S
G
S
S
S
M
M
TH
TH
VTH
VTH
VTH
TH
VTH
VTH
VTH
VTH
TK-M
TK
TH
M-TH
VTH
400
380
360
340
320
100
120
110
100
30
SEG A
PH91KF15
n=4
242°
PH91KF14
PH91KF13
PH91KF12a
PH91KF12
PH91KF11
PH91KF10
Micrite grades upward to wackestone, local breccia at top of bed.
Thickness and abundance of ss beds increases upward.
Covered two feet above top of siltstone; mudstone at base of interbedded sand stone and siltstone unit.
Local laminations of mudstone.
Offset section to south, began measuring segment B on top of Leadville Lmst. Hermosa Fm covered from top of Leadville to 330' in segment B.
Bedding surfaces planar to wavy and irregular; silica spar filling molds; petroliferous smell.
Very thin beds of shaly limestone interbedded with wackestone; petroliferous smell.
Carbonaceous shale at top of claystone.

figure 4, p. 2

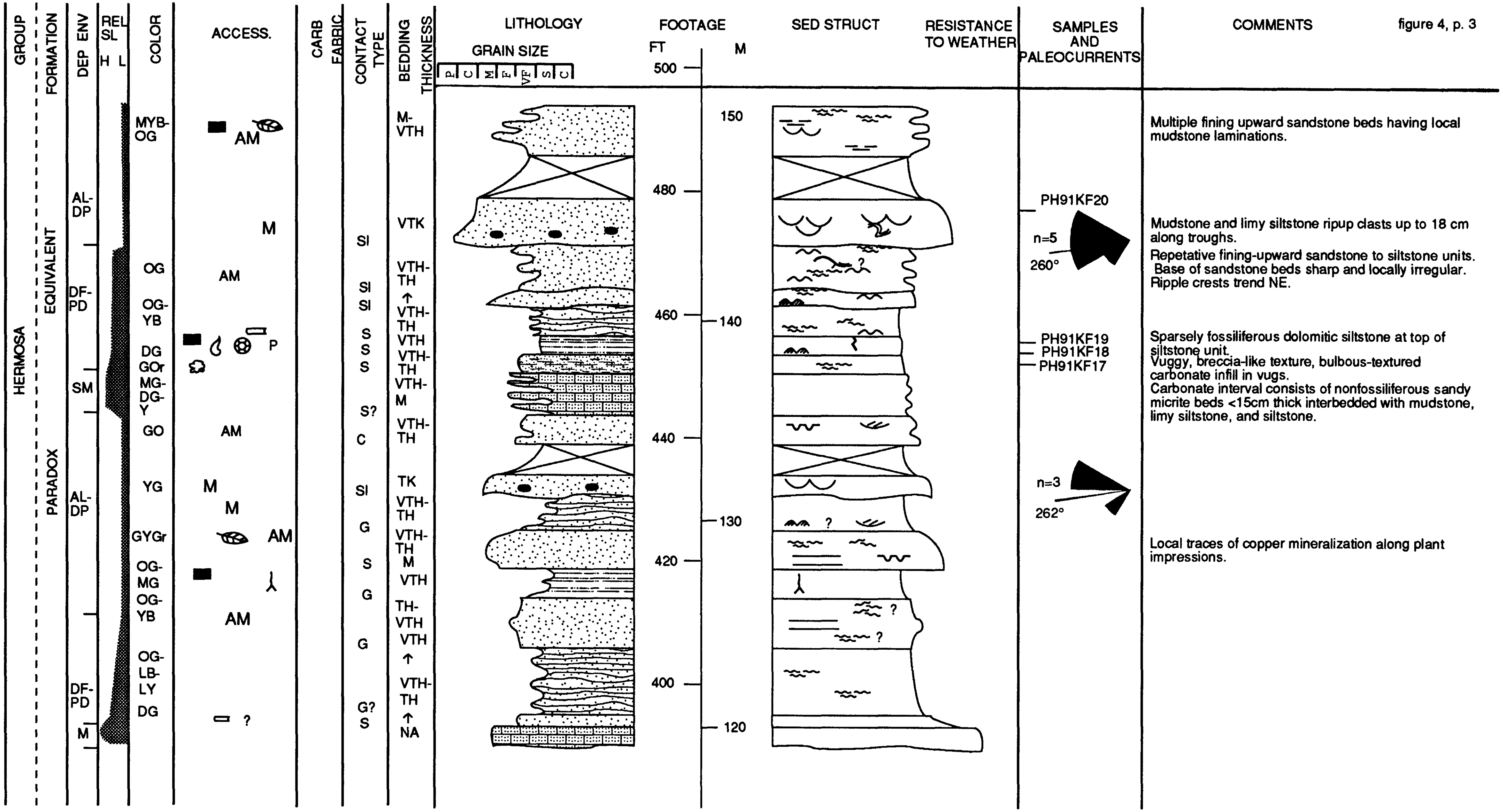


figure 4, p. 3
GROUP
FORMATION
DEP ENV
REL SL
H L
COLOR
ACCESS.
CARB FABRIC
CONTACT TYPE
BEDDING THICKNESS
LITHOLOGY
GRAIN SIZE
P C M F VF S C
FOOTAGE
FT
M
SED STRUCT
RESISTANCE TO WEATHER
SAMPLES AND PALEOCURRENTS
COMMENTS
HERMOSA
PARADOX
EQUIVALENT
AL-DP
DF-PD
SM
AL-DP
DF-PD
M
MYB-OG
OG
OG-YB
DG
GOr
MG-
DG-
Y
GO
YG
GYGr
OG-MG
OG-YB
OG-LB-LY
DG
AM
M
AM
P
AM
M
M
AM
AM
?
SI
SI
SI
S
S
S
S?
C
SI
G
S
G
G
G?
S
M-VTH
VTK
VTH-TH
VTH-TH
VTH
VTH-TH
VTH-M
VTH-TH
TK
VTH-TH
VTH-TH
M
VTH
TH-VTH
VTH
VTH-TH
NA
500
480
460
440
420
400
150
140
130
120
PH91KF20
n=5
260°
PH91KF19
PH91KF18
PH91KF17
n=3
262°
Multiple fining upward sandstone beds having local mudstone laminations.
Mudstone and limy siltstone ripup clasts up to 18 cm along troughs.
Repetative fining-upward sandstone to siltstone units. Base of sandstone beds sharp and locally irregular. Ripple crests trend NE.
Sparsely fossiliferous dolomitic siltstone at top of siltstone unit.
Vuggy, breccia-like texture, bulbous-textured carbonate infill in vugs.
Carbonate interval consists of nonfossiliferous sandy micrite beds <15cm thick interbedded with mudstone, limy siltstone, and siltstone.
Local traces of copper mineralization along plant impressions.

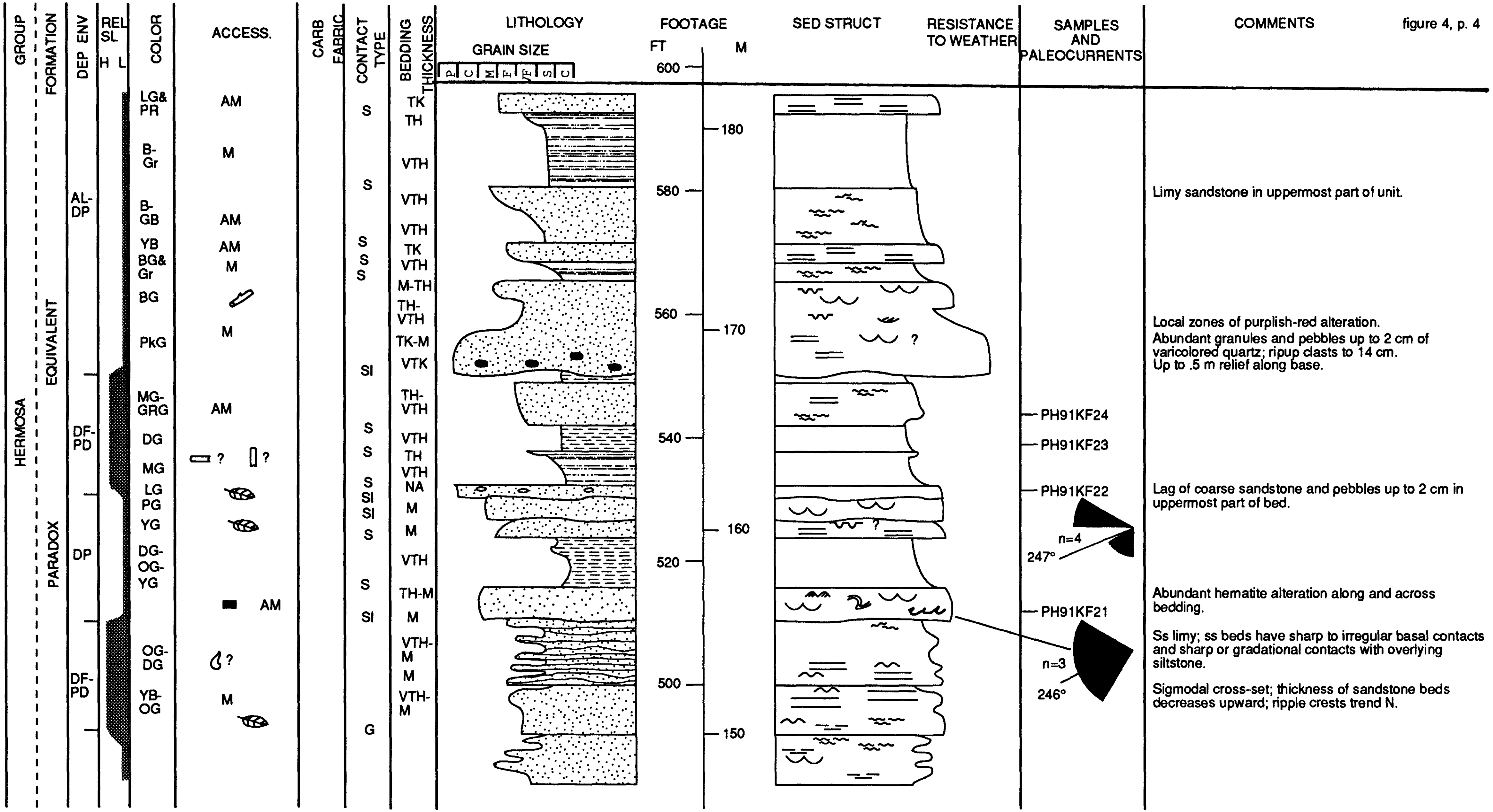


figure 4, p. 4
GROUP
FORMATION
DEP ENV
REL SL
H L
COLOR
ACCESS.
CARB FABRIC
CONTACT TYPE
BEDDING THICKNESS
LITHOLOGY
GRAIN SIZE
P C M F VF S C
FOOTAGE
FT
M
SED STRUCT
RESISTANCE TO WEATHER
SAMPLES AND PALEOCURRENTS
COMMENTS
HERMOSA
PARADOX
EQUIVALENT
AL-DP
DF-PD
DP
DF-PD
LG& PR
B-Gr
B-GB
YB
BG& Gr
BG
PkG
MG-GRG
DG
MG
LG
PG
YG
DG-OG-YG
OG-DG
YB-OG
AM
M
AM
AM
M
M
AM
?
?
AM
?
M
S
S
S
S
S
SI
S
S
S
SI
SI
S
S
SI
G
TK
TH
VTH
VTH
VTH
TK
VTH
M-TH
TH-VTH
TK-M
VTK
TH-VTH
VTH
TH
VTH
NA
M
M
VTH
TH-M
M
VTH-M
M
VTH-M
600
580
560
540
520
500
180
170
160
150
?
?
PH91KF24
PH91KF23
PH91KF22
n=4
247°
PH91KF21
n=3
246°
Limy sandstone in uppermost part of unit.
Local zones of purplish-red alteration.
Abundant granules and pebbles up to 2 cm of varicolored quartz; ripup clasts to 14 cm.
Up to .5 m relief along base.
Lag of coarse sandstone and pebbles up to 2 cm in uppermost part of bed.
Abundant hematite alteration along and across bedding.
Ss limy; ss beds have sharp to irregular basal contacts and sharp or gradational contacts with overlying siltstone.
Sigmodal cross-set; thickness of sandstone beds decreases upward; ripple crests trend N.

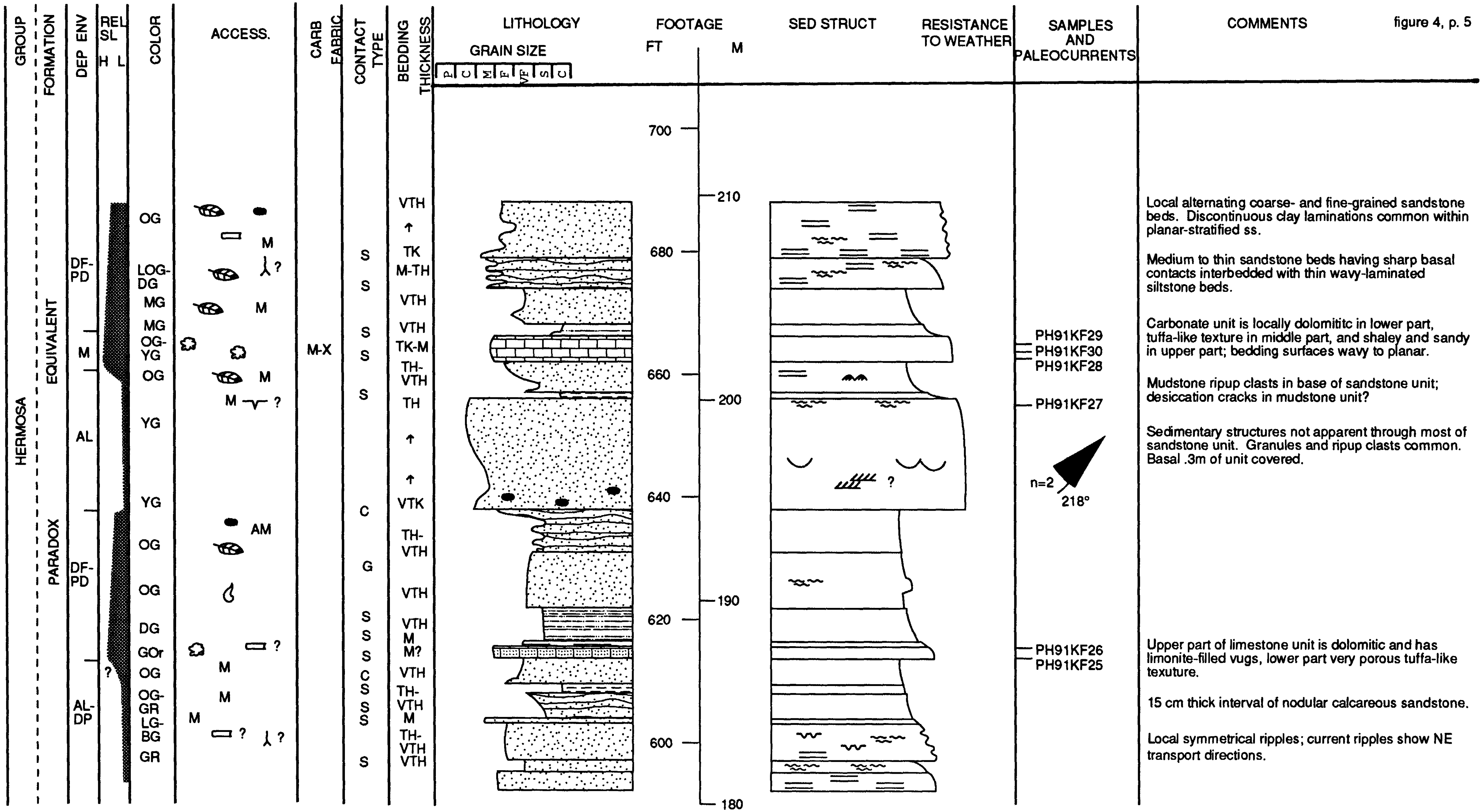
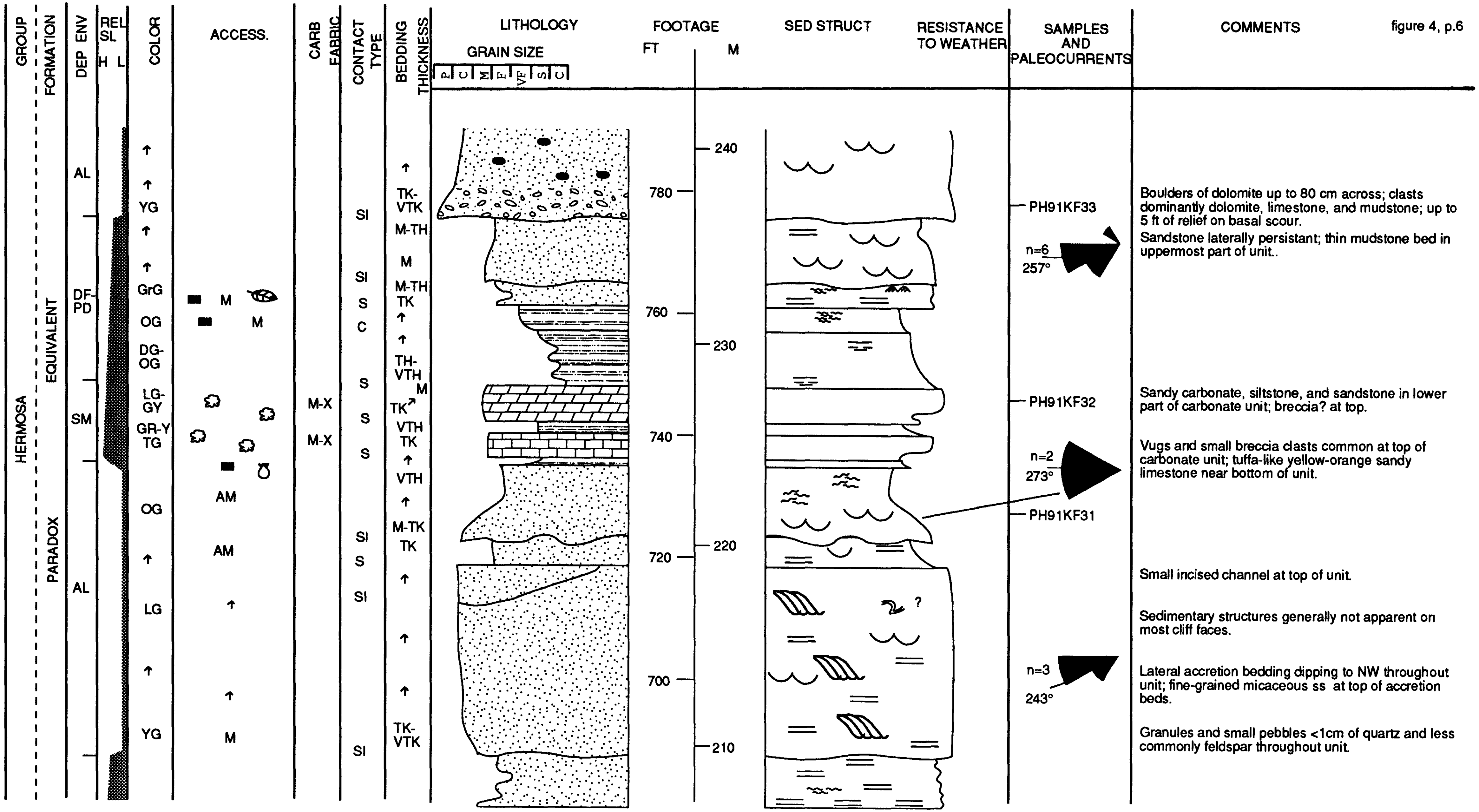
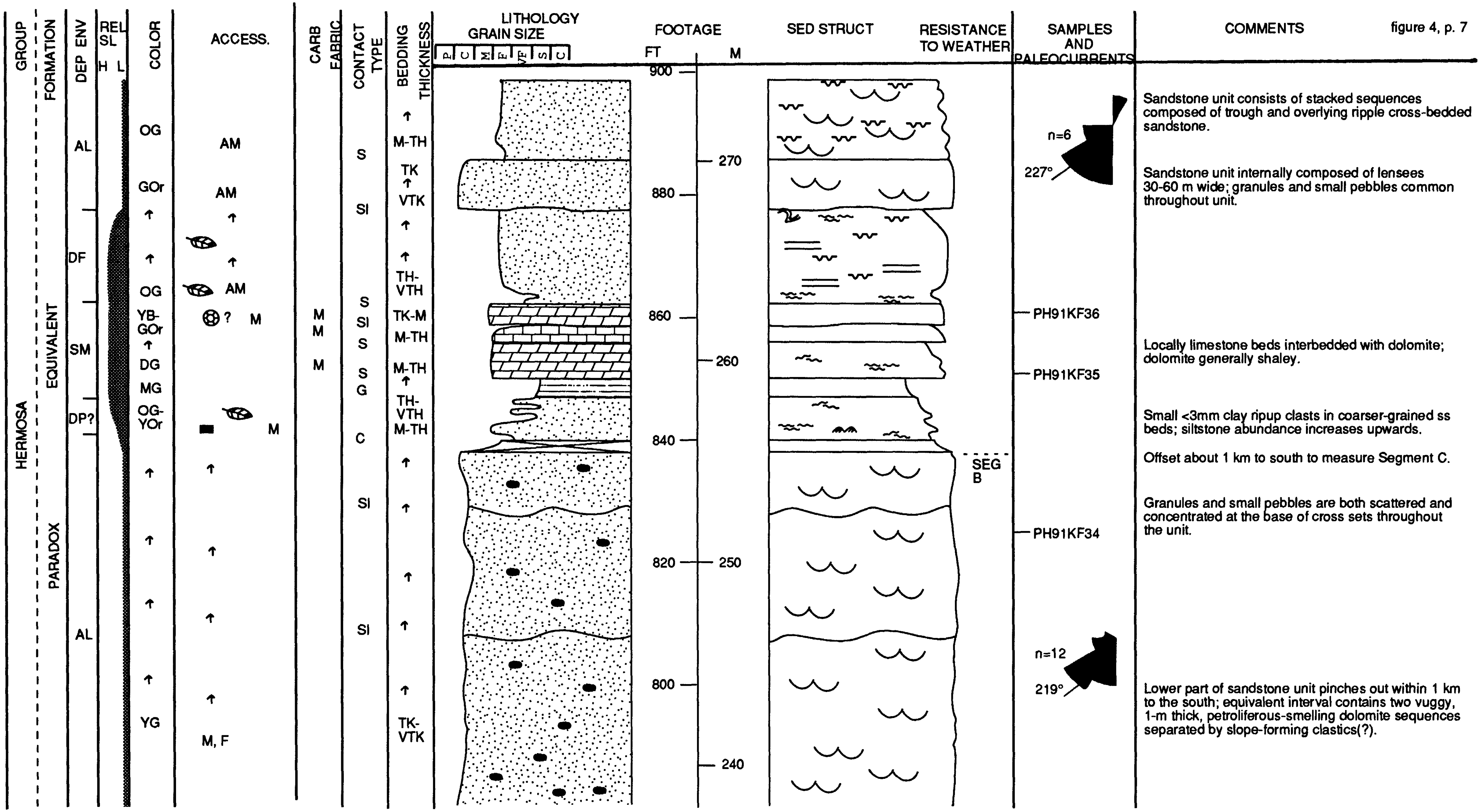


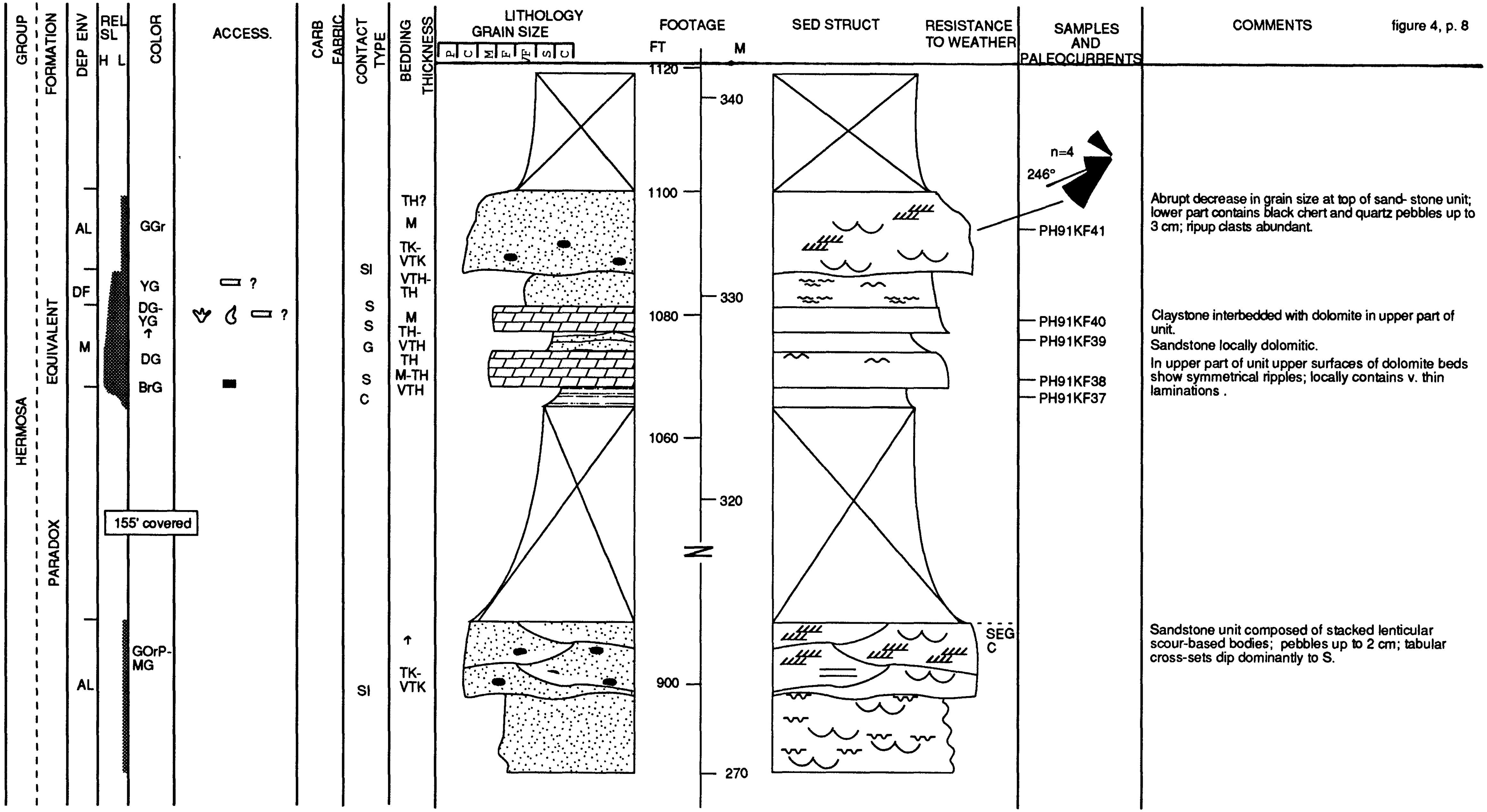
figure 4, p. 5
GROUP
FORMATION
DEP ENV
REL SL
H L
COLOR
ACCESS.
CARB FABRIC
CONTACT TYPE
BEDDING THICKNESS
LITHOLOGY
GRAIN SIZE
P C M F VF S C
FOOTAGE
FT
M
SED STRUCT
RESISTANCE TO WEATHER
SAMPLES AND PALEOCURRENTS
COMMENTS
HERMOSA
PARADOX
EQUIVALENT
DF-PD
M
AL
DF-PD
AL-DP
OG
LOG-DG
MG
MG
OG-YG
OG
YG
YG
OG
OG
DG
GOr
OG
OG-GR
LG-BG
GR
M
M
M
M
AM
M
M
M
M
M-X
S
S
S
S
S
C
G
S
S
S
C
S
S
S
S
VTH
TK
M-TH
VTH
VTH
TK-M
TH-VTH
TH
VTK
TH-VTH
VTH
VTH
M
M?
VTH
TH-VTH
M
TH-VTH
VTH
700
680
660
640
620
600
210
200
190
180
PH91KF29
PH91KF30
PH91KF28
PH91KF27
n=2
218°
PH91KF26
PH91KF25
Local alternating coarse- and fine-grained sandstone beds. Discontinuous clay laminations common within planar-stratified ss.
Medium to thin sandstone beds having sharp basal contacts interbedded with thin wavy-laminated siltstone beds.
Carbonate unit is locally dolomititc in lower part, tuffa-like texture in middle part, and shaley and sandy in upper part; bedding surfaces wavy to planar.
Mudstone ripup clasts in base of sandstone unit; desiccation cracks in mudstone unit?
Sedimentary structures not apparent through most of sandstone unit. Granules and ripup clasts common. Basal .3m of unit covered.
Upper part of limestone unit is dolomitic and has limonite-filled vugs, lower part very porous tuffa-like texuture.
15 cm thick interval of nodular calcareous sandstone.
Local symmetrical ripples; current ripples show NE transport directions.



GROUP
FORMATION
DEP ENV
REL SL
H L
COLOR
ACCESS.
CARB FABRIC
CONTACT TYPE
BEDDING THICKNESS
LITHOLOGY
GRAIN SIZE
P C M F VF S C
FOOTAGE
FT
M
SED STRUCT
RESISTANCE TO WEATHER
SAMPLES AND PALEOCURRENTS
COMMENTS
figure 4, p.6
HERMOSA
EQUIVALENT
PARADOX
AL
DF-PD
SM
AL
YG
GrG
OG
DG-OG
LG-GY
GR-Y TG
OG
LG
YG
M
M
AM
AM
M
M-X
M-X
SI
SI
S
C
S
S
S
SI
S
SI
SI
TK-VTK
M-TH
M
M-TH TK
TH-VTH
M
TK
VTH TK
VTH
M-TK TK
TK-VTK
240
780
760
230
740
720
220
700
210
?
PH91KF33
n=6
257°
PH91KF32
n=2
273°
PH91KF31
n=3
243°
Boulders of dolomite up to 80 cm across; clasts dominantly dolomite, limestone, and mudstone; up to 5 ft of relief on basal scour.
Sandstone laterally persistant; thin mudstone bed in uppermost part of unit..
Sandy carbonate, siltstone, and sandstone in lower part of carbonate unit; breccia? at top.
Vugs and small breccia clasts common at top of carbonate unit; tuffa-like yellow-orange sandy limestone near bottom of unit.
Small incised channel at top of unit.
Sedimentary structures generally not apparent on most cliff faces.
Lateral accretion bedding dipping to NW throughout unit; fine-grained micaceous ss at top of accretion beds.
Granules and small pebbles <1cm of quartz and less commonly feldspar throughout unit.



GROUP
FORMATION
DEP ENV
REL SL
H L
COLOR
ACCESS.
CARB FABRIC
CONTACT TYPE
BEDDING THICKNESS
LITHOLOGY GRAIN SIZE
P C M F VF S C
FOOTAGE
FT
M
SED STRUCT
RESISTANCE TO WEATHER
SAMPLES AND PALEOCURRENTS
COMMENTS
figure 4, p. 7
HERMOSA
PARADOX
EQUIVALENT
AL
DF
SM
DP?
AL
OG
GOr
OG
YB-GOr
DG
MG
OG-YOr
YG
AM
AM
AM
? M
M
M, F
M
M
M
S
SI
S
SI
S
S
G
C
SI
SI
M-TH
TK
VTK
TH-VTH
TK-M
M-TH
M-TH
TH-VTH
M-TH
TK-VTK
900
880
860
840
820
800
270
260
250
240
SEG B
n=6
227°
PH91KF36
PH91KF35
PH91KF34
n=12
219°
Sandstone unit consists of stacked sequences composed of trough and overlying ripple cross-bedded sandstone.
Sandstone unit internally composed of lensees 30-60 m wide; granules and small pebbles common throughout unit.
Locally limestone beds interbedded with dolomite; dolomite generally shaley.
Small <3mm clay ripup clasts in coarser-grained ss beds; siltstone abundance increases upwards.
Offset about 1 km to south to measure Segment C.
Granules and small pebbles are both scattered and concentrated at the base of cross sets throughout the unit.
Lower part of sandstone unit pinches out within 1 km to the south; equivalent interval contains two vuggy, 1-m thick, petroliferous-smelling dolomite sequences separated by slope-forming clastics(?).



GROUP
FORMATION
DEP ENV
REL SL
H L
COLOR
ACCESS.
CARB FABRIC
CONTACT TYPE
BEDDING THICKNESS
LITHOLOGY
GRAIN SIZE
P C M F VF S C
FOOTAGE
FT
M
SED STRUCT
RESISTANCE TO WEATHER
SAMPLES AND PALEOCURRENTS
COMMENTS
figure 4, p. 8
HERMOSA
EQUIVALENT
PARADOX
AL
DF
M
AL
GGr
YG
DG-YG
DG
BrG
GOrP-MG
155' covered
SI
S
S
G
S
C
SI
TH?
M
TK-VTK
VTH-TH
M
TH-VTH
TH
M-TH
VTH
TK-VTK
1120
1100
1080
1060
900
340
330
320
270
SEG C
n=4
246°
PH91KF41
PH91KF40
PH91KF39
PH91KF38
PH91KF37
Abrupt decrease in grain size at top of sand- stone unit; lower part contains black chert and quartz pebbles up to 3 cm; ripup clasts abundant.
Claystone interbedded with dolomite in upper part of unit.
Sandstone locally dolomitic.
In upper part of unit upper surfaces of dolomite beds show symmetrical ripples; locally contains v. thin laminations .
Sandstone unit composed of stacked lenticular scour-based bodies; pebbles up to 2 cm; tabular cross-sets dip dominantly to S.

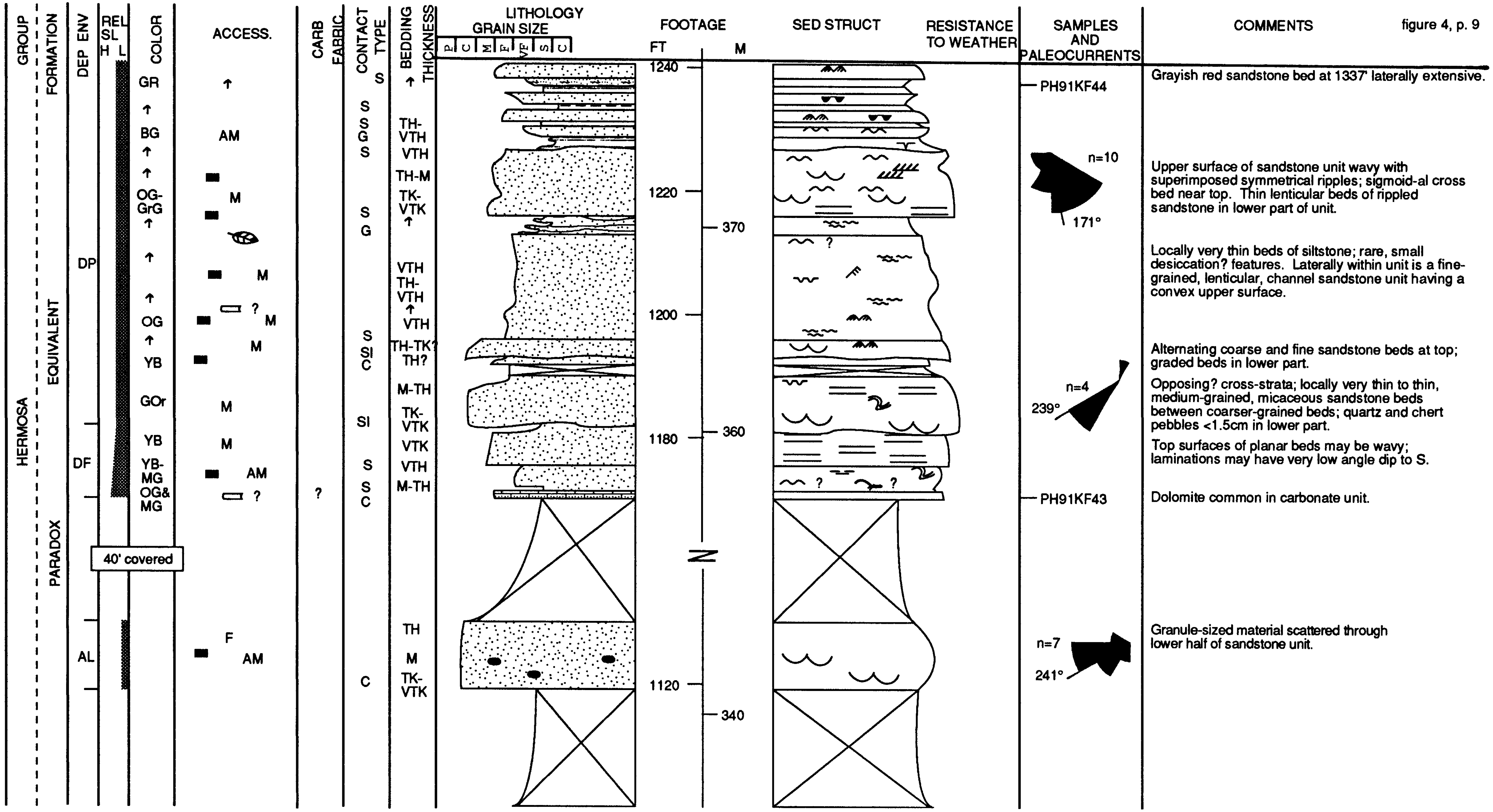
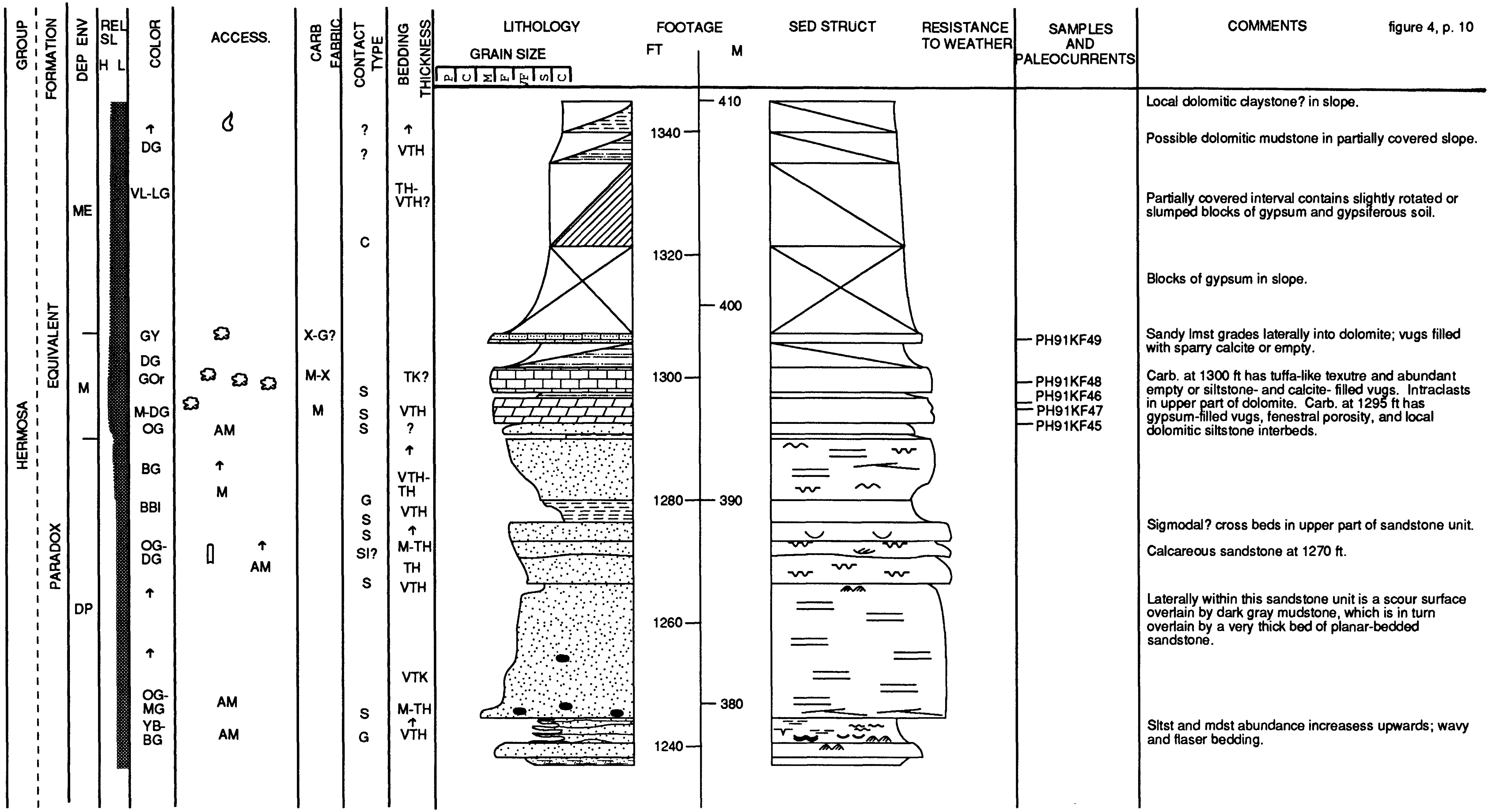
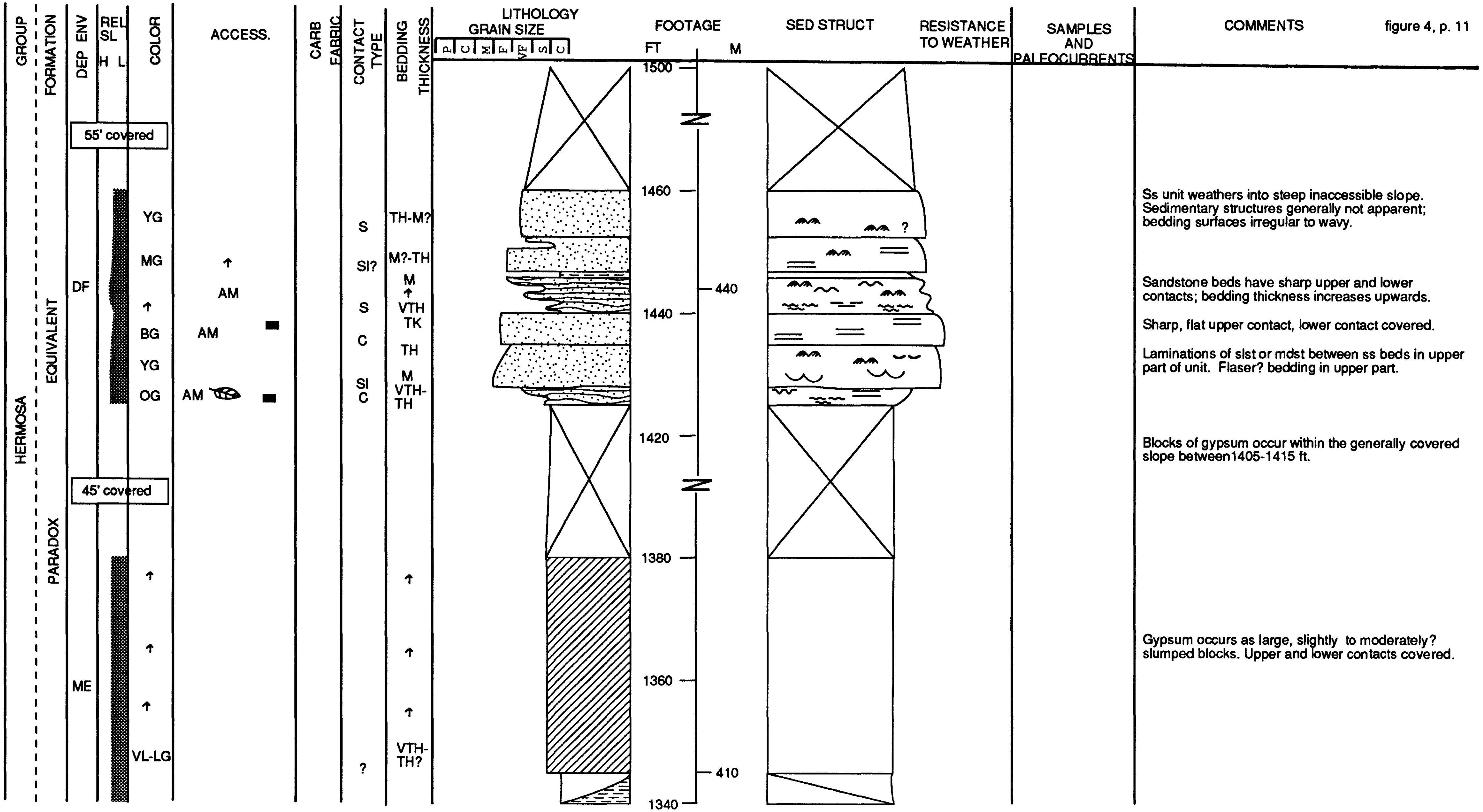
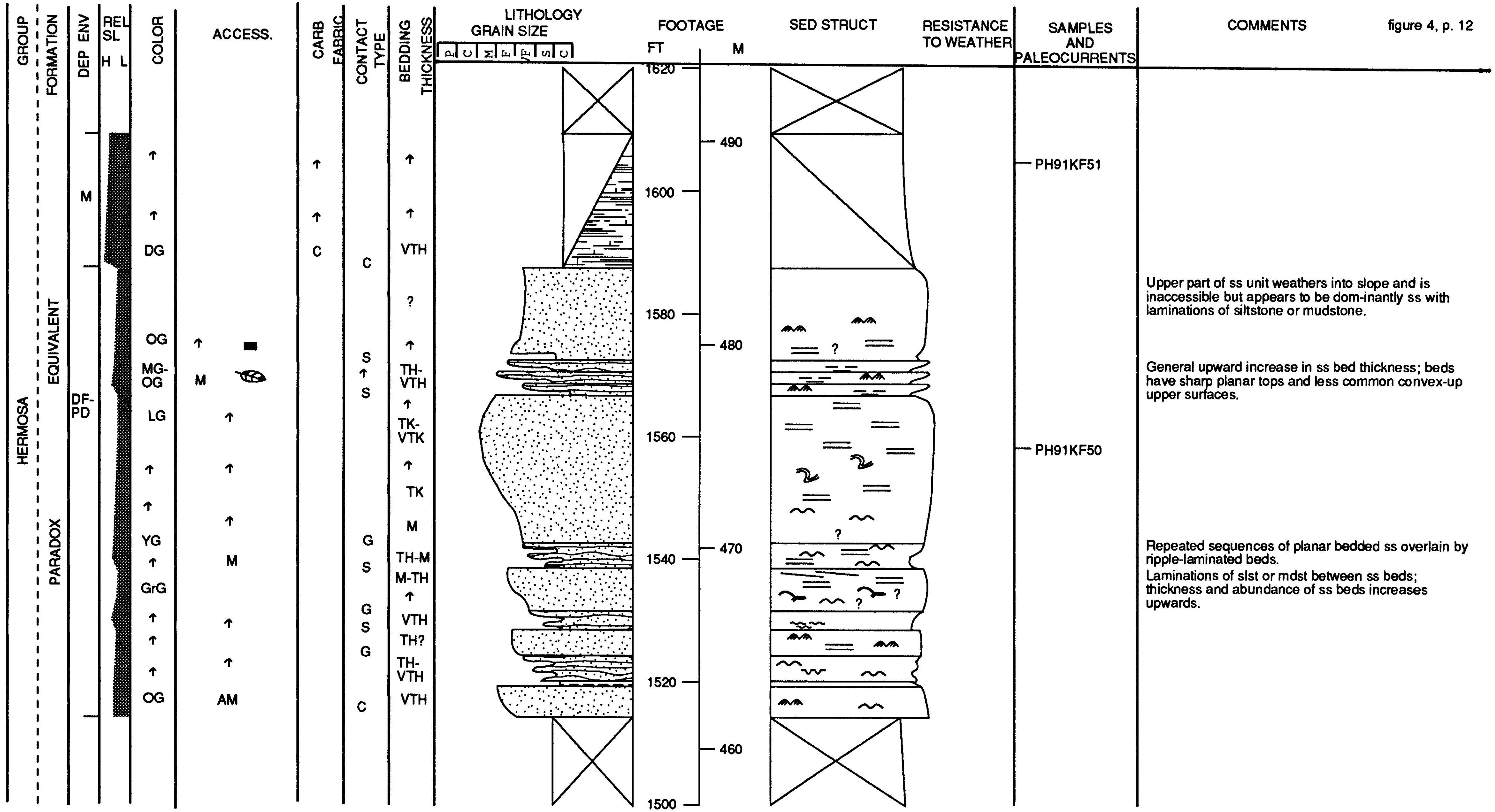


figure 4, p. 9
GROUP
FORMATION
DEP ENV
REL SL H L
COLOR
ACCESS.
CARB FABRIC
CONTACT TYPE
BEDDING THICKNESS
LITHOLOGY GRAIN SIZE
FOOTAGE
FT
M
SED STRUCT
RESISTANCE TO WEATHER
SAMPLES AND PALEOCURRENTS
COMMENTS
HERMOSA
PARADOX
EQUIVALENT
DP
DF
AL
40' covered
1240
1220
1200
1180
1120
370
360
340
PH91KF44
PH91KF43
n=10
171°
n=4
239°
n=7
241°
Grayish red sandstone bed at 1337' laterally extensive.
Upper surface of sandstone unit wavy with superimposed symmetrical ripples; sigmoid-al cross bed near top. Thin lenticular beds of rippled sandstone in lower part of unit.
Locally very thin beds of siltstone; rare, small desiccation? features. Laterally within unit is a fine-grained, lenticular, channel sandstone unit having a convex upper surface.
Alternating coarse and fine sandstone beds at top; graded beds in lower part.
Opposing? cross-strata; locally very thin to thin, medium-grained, micaceous sandstone beds between coarser-grained beds; quartz and chert pebbles <1.5cm in lower part.
Top surfaces of planar beds may be wavy; laminations may have very low angle dip to S.
Dolomite common in carbonate unit.
Granule-sized material scattered through lower half of sandstone unit.


GROUP
FORMATION
DEP ENV
REL SL
H L
COLOR
ACCESS.
CARB FABRIC
CONTACT TYPE
BEDDING THICKNESS
LITHOLOGY
GRAIN SIZE
P C M F VF S C
FOOTAGE
FT
M
SED STRUCT
RESISTANCE TO WEATHER
SAMPLES AND PALEOCURRENTS
COMMENTS
figure 4, p. 10
HERMOSA
PARADOX
EQUIVALENT
ME
M
DP
DG
VL-LG
GY
DG
GOr
M-DG
OG
BG
BBI
OG-
DG
OG-
MG
YB-
BG
AM
M
AM
AM
AM
X-G?
M-X
M
?
?
C
S
S
S
G
S
S
SI?
S
S
G
VTH
TH-
VTH?
TK?
VTH
?
VTH-
TH
VTH
M-TH
TH
VTH
VTK
M-TH
VTH
410
1340
1320
400
1300
1280
390
1260
380
1240
PH91KF49
PH91KF48
PH91KF46
PH91KF47
PH91KF45
Local dolomitic claystone? in slope.
Possible dolomitic mudstone in partially covered slope.
Partially covered interval contains slightly rotated or slumped blocks of gypsum and gypsiferous soil.
Blocks of gypsum in slope.
Sandy lmst grades laterally into dolomite; vugs filled with sparry calcite or empty.
Carb. at 1300 ft has tuffa-like texutre and abundant empty or siltstone- and calcite- filled vugs. Intraclasts in upper part of dolomite. Carb. at 1295 ft has gypsum-filled vugs, fenestral porosity, and local dolomitic siltstone interbeds.
Sigmodal? cross beds in upper part of sandstone unit.
Calcareous sandstone at 1270 ft.
Laterally within this sandstone unit is a scour surface overlain by dark gray mudstone, which is in turn overlain by a very thick bed of planar-bedded sandstone.
Sltst and mdst abundance increasess upwards; wavy and flaser bedding.


GROUP
FORMATION
DEP ENV
REL SL
H L
COLOR
ACCESS.
CARB FABRIC
CONTACT TYPE
BEDDING THICKNESS
LITHOLOGY
GRAIN SIZE
P C M F VF S C
FOOTAGE
FT
M
SED STRUCT
RESISTANCE TO WEATHER
SAMPLES AND PALEOCURRENTS
COMMENTS
figure 4, p. 11
HERMOSA
EQUIVALENT
PARADOX
55' covered
45' covered
DF
ME
YG
MG
BG
YG
OG
VL-LG
AM
AM
AM
S
Sl?
S
C
Sl
C
?
TH-M?
M?-TH
M
VTH
TK
TH
M
VTH-
TH
VTH-
TH?
1500
1460
1440
1420
1380
1360
1340
440
410
Ss unit weathers into steep inaccessible slope. Sedimentary structures generally not apparent; bedding surfaces irregular to wavy.
Sandstone beds have sharp upper and lower contacts; bedding thickness increases upwards.
Sharp, flat upper contact, lower contact covered.
Laminations of slst or mdst between ss beds in upper part of unit. Flaser? bedding in upper part.
Blocks of gypsum occur within the generally covered slope between1405-1415 ft.
Gypsum occurs as large, slightly to moderately? slumped blocks. Upper and lower contacts covered.



GROUP
FORMATION
DEP ENV
REL SL
H L
COLOR
ACCESS.
CARB FABRIC
CONTACT TYPE
BEDDING THICKNESS
LITHOLOGY
GRAIN SIZE
P C M F VF S C
FOOTAGE
FT
M
SED STRUCT
RESISTANCE TO WEATHER
SAMPLES AND PALEOCURRENTS
COMMENTS
figure 4, p. 12
HERMOSA
PARADOX
EQUIVALENT
M
DF-PD
DG
OG
MG-OG
LG
YG
GrG
OG
M
AM
C
C
S
S
G
S
G
S
G
C
VTH
?
TH-VTH
TK-VTK
TK
M
TH-M
M-TH
VTH
TH?
TH-VTH
VTH
1620
1600
1580
1560
1540
1520
1500
490
480
470
460
PH91KF51
PH91KF50
Upper part of ss unit weathers into slope and is inaccessible but appears to be dom-inantly ss with laminations of siltstone or mudstone.
General upward increase in ss bed thickness; beds have sharp planar tops and less common convex-up upper surfaces.
Repeated sequences of planar bedded ss overlain by ripple-laminated beds.
Laminations of slst or mdst between ss beds; thickness and abundance of ss beds increases upwards.

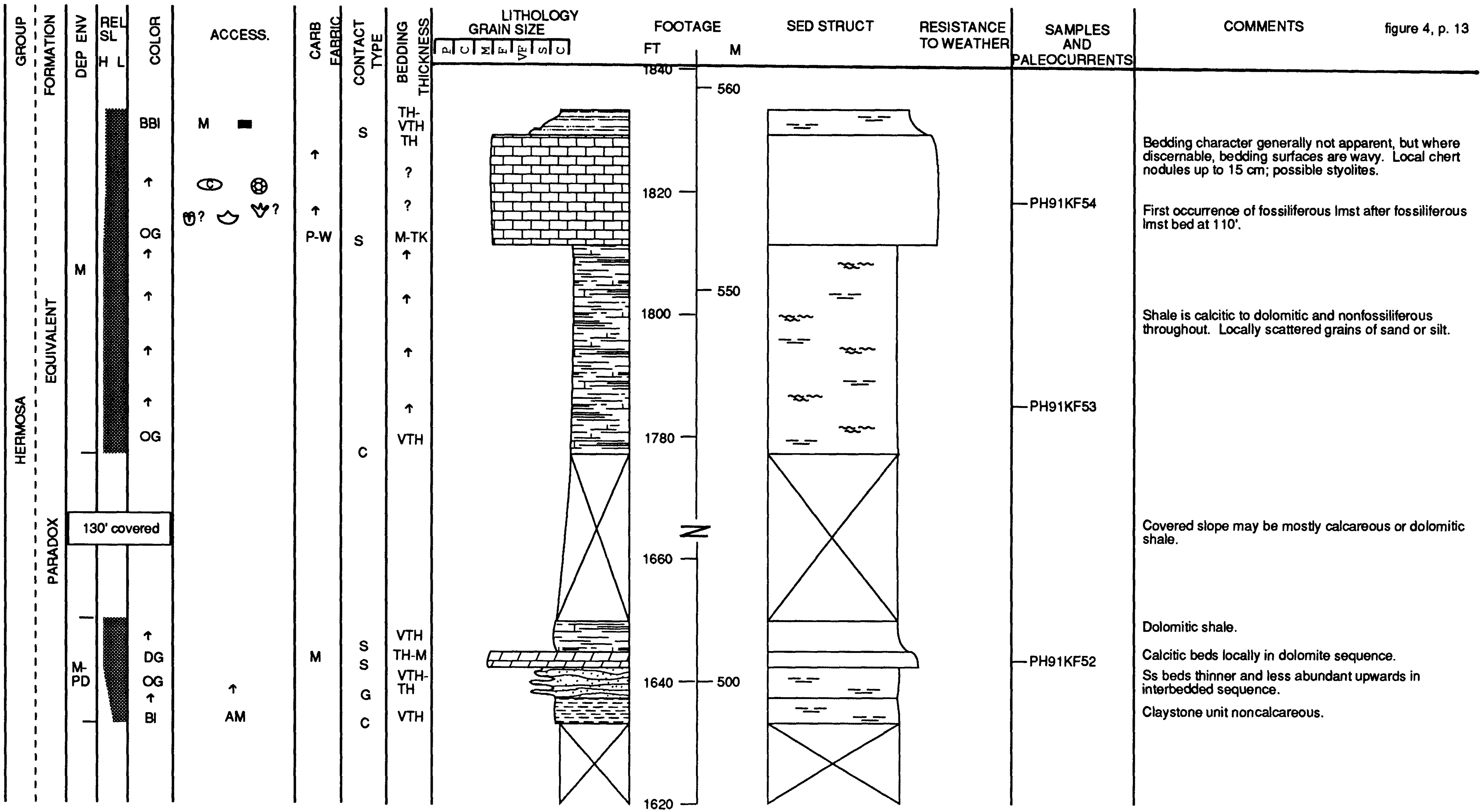


figure 4, p. 13
GROUP
FORMATION
DEP ENV
REL SL
H L
COLOR
ACCESS.
CARB FABRIC
CONTACT TYPE
BEDDING THICKNESS
LITHOLOGY
GRAIN SIZE
P C M F VF S C
FOOTAGE
FT
M
SED STRUCT
RESISTANCE TO WEATHER
SAMPLES AND PALEOCURRENTS
COMMENTS
HERMOSA
PARADOX
EQUIVALENT
M
M-PD
130' covered
BBI
OG
OG
DG
OG
BI
M
AM
P-W
M
S
S
C
S
S
G
C
TH-VTH TH
?
?
M-TK
VTH
VTH
TH-M
VTH-TH
VTH
1840
1820
1800
1780
1660
1640
1620
560
550
500
PH91KF54
PH91KF53
PH91KF52
Bedding character generally not apparent, but where discernable, bedding surfaces are wavy. Local chert nodules up to 15 cm; possible stylolites.
First occurrence of fossiliferous lmst after fossiliferous lmst bed at 110'.
Shale is calcitic to dolomitic and nonfossiliferous throughout. Locally scattered grains of sand or silt.
Covered slope may be mostly calcareous or dolomitic shale.
Dolomitic shale.
Calcitic beds locally in dolomite sequence.
Ss beds thinner and less abundant upwards in interbedded sequence.
Claystone unit noncalcareous.

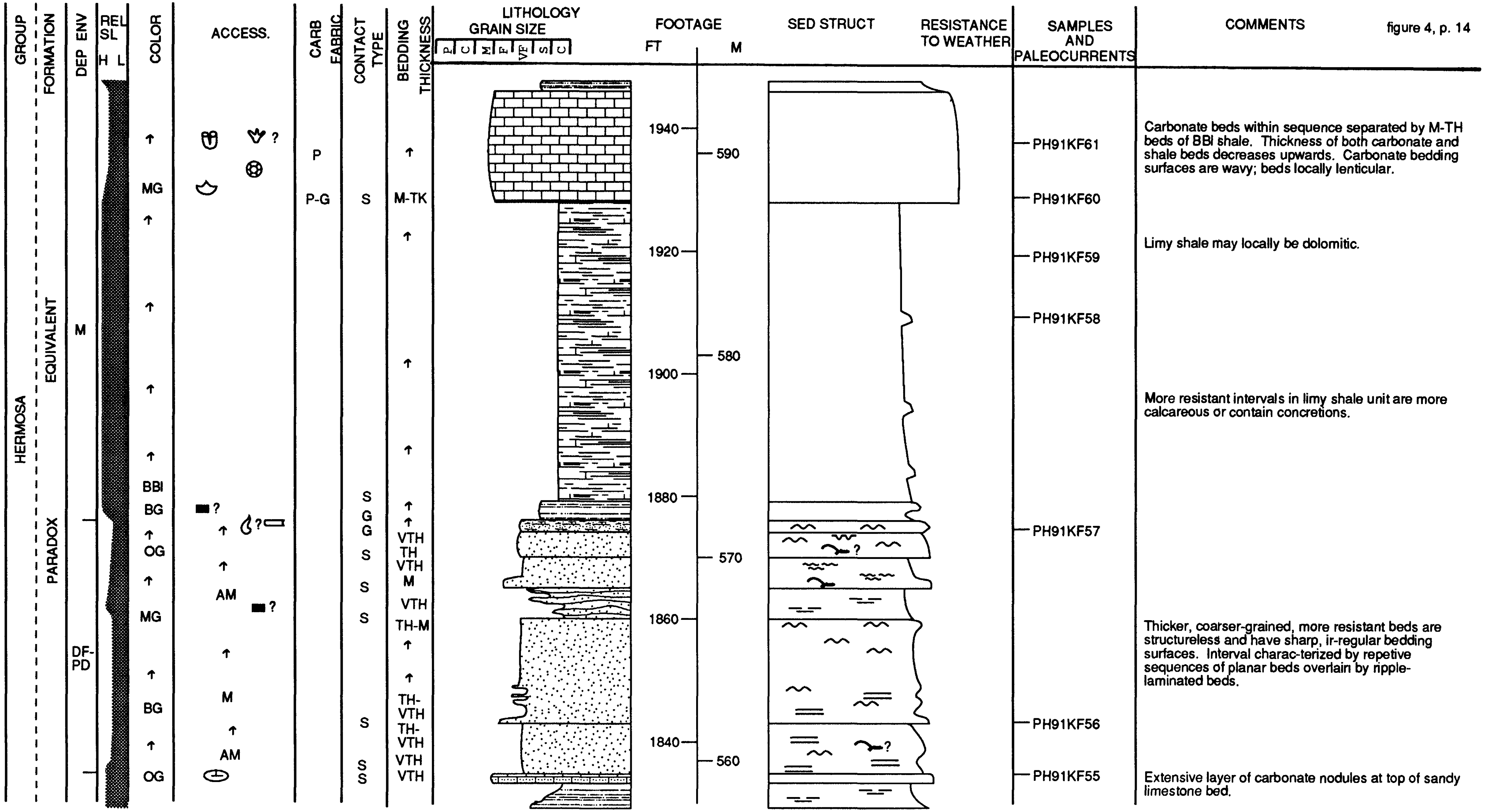


figure 4, p. 14
GROUP
FORMATION
DEP ENV
REL SL
H L
COLOR
ACCESS.
CARB FABRIC
CONTACT TYPE
BEDDING THICKNESS
LITHOLOGY
GRAIN SIZE
P C M F VF S C
FOOTAGE
FT
M
SED STRUCT
RESISTANCE TO WEATHER
SAMPLES AND PALEOCURRENTS
COMMENTS
HERMOSA
PARADOX
EQUIVALENT
M
DF-PD
MG
BBI
BG
OG
MG
BG
OG
AM
M
AM
P
P-G
S
G
G
S
S
S
S
S
S
M-TK
VTH
TH
VTH
M
VTH
TH-M
TH-VTH
TH-VTH
VTH
VTH
1940
1920
1900
1880
1860
1840
590
580
570
560
PH91KF61
PH91KF60
PH91KF59
PH91KF58
PH91KF57
PH91KF56
PH91KF55
Carbonate beds within sequence separated by M-TH beds of BBI shale. Thickness of both carbonate and shale beds decreases upwards. Carbonate bedding surfaces are wavy; beds locally lenticular.
Limy shale may locally be dolomitic.
More resistant intervals in limy shale unit are more calcareous or contain concretions.
Thicker, coarser-grained, more resistant beds are structureless and have sharp, ir-regular bedding surfaces. Interval charac-terized by repetive sequences of planar beds overlain by ripple-laminated beds.
Extensive layer of carbonate nodules at top of sandy limestone bed.

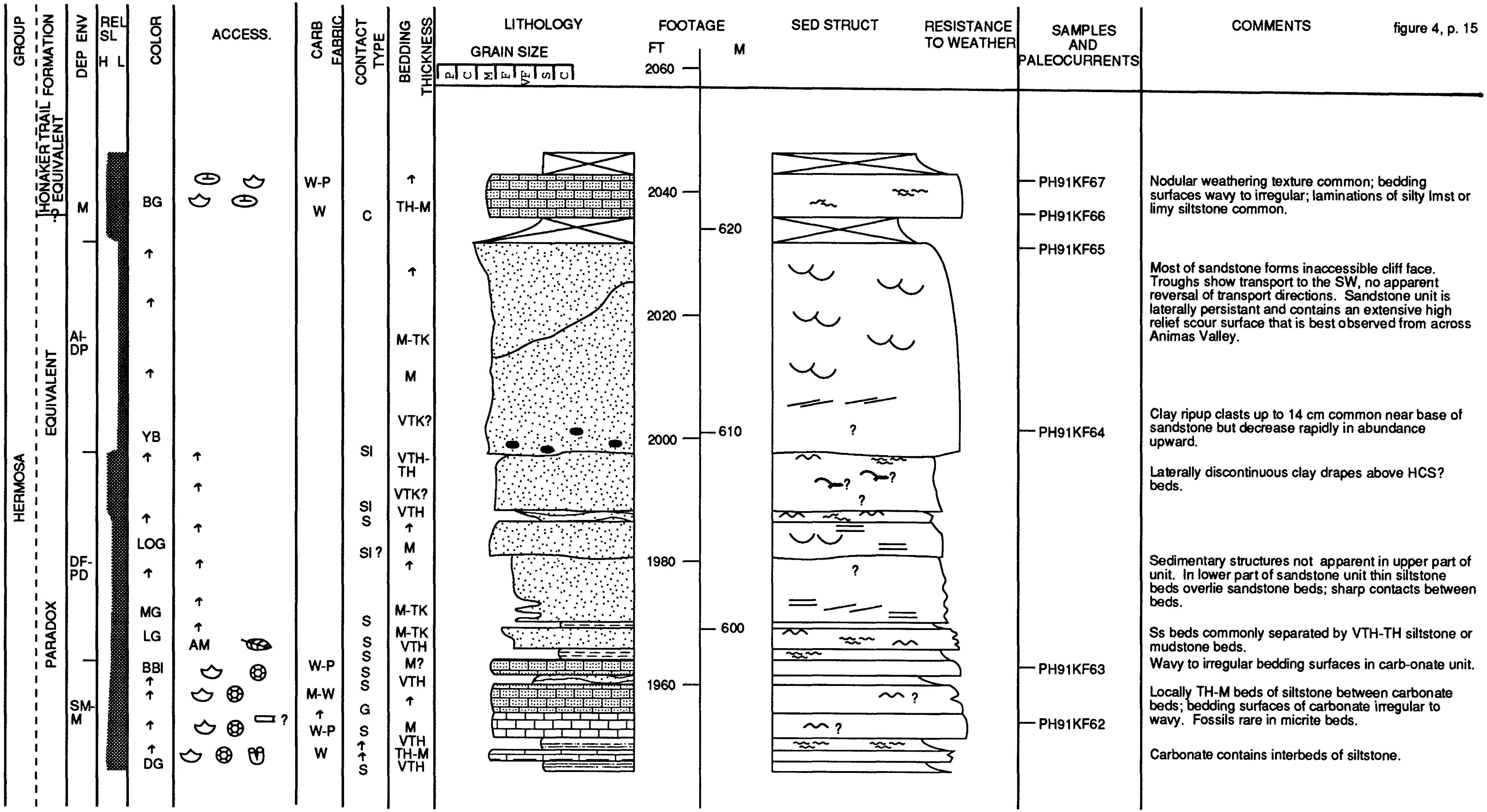
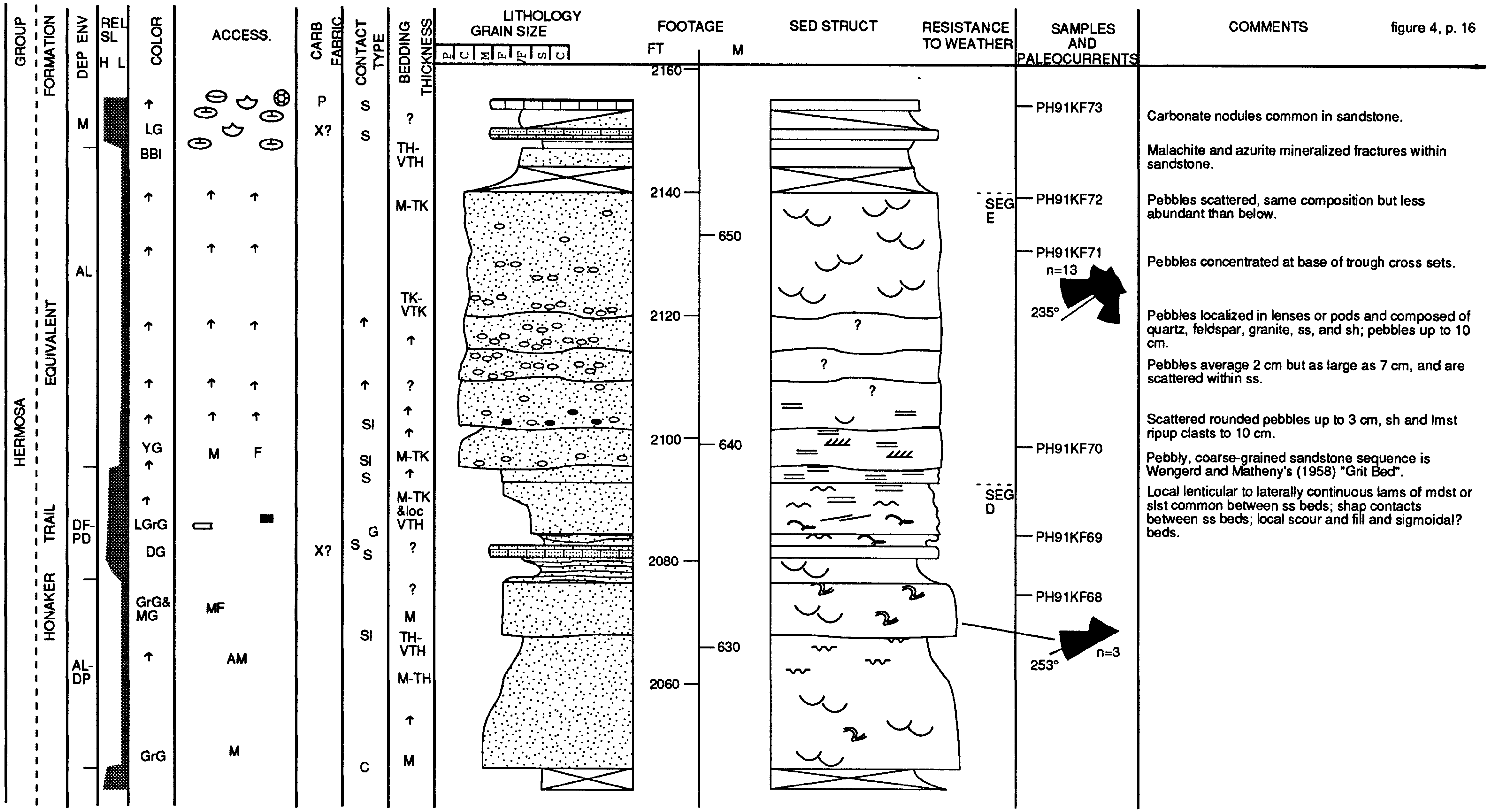
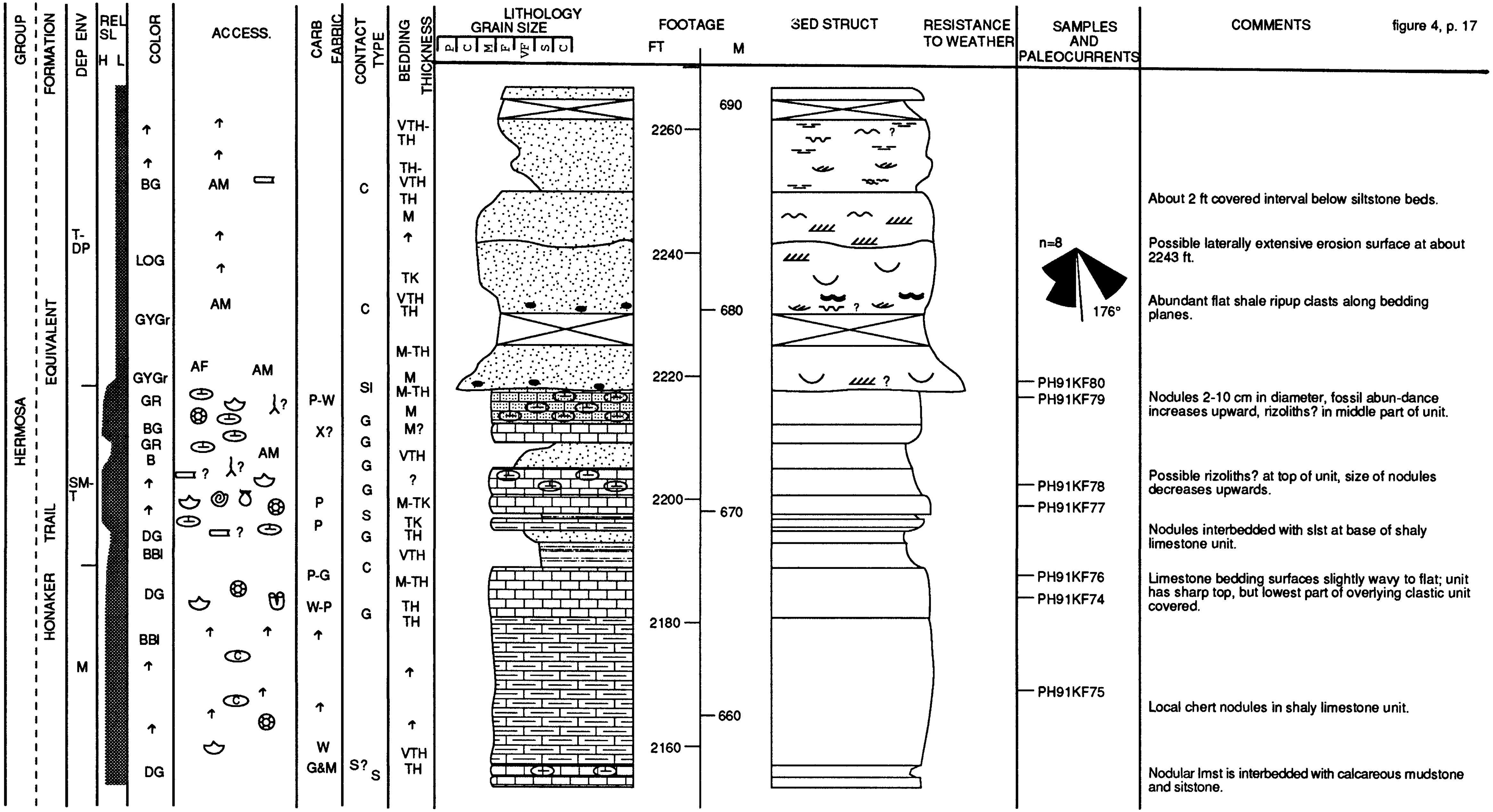


figure 4, p. 15
GROUP
FORMATION
DEP ENV
REL SL
H L
COLOR
ACCESS.
CARB FABRIC
CONTACT TYPE
BEDDING THICKNESS
LITHOLOGY
GRAIN SIZE
P C M F VF S C
FOOTAGE
FT
M
SED STRUCT
RESISTANCE TO WEATHER
SAMPLES AND PALEOCURRENTS
COMMENTS
HERMOSA
PARADOX
EQUIVALENT
HONAKER TRAIL EQUIVALENT
M
Al-DP
DF-PD
SM-M
BG
YB
LOG
MG
LG
BBI
DG
AM
W-P
W
M-W
C
Sl
Sl?
S
G
TH-M
M-TK
M
VTK?
VTH-TH
VTH
M-TK
M?
2060
2040
2020
2000
1980
1960
620
610
600
PH91KF67
PH91KF66
PH91KF65
PH91KF64
PH91KF63
PH91KF62
Nodular weathering texture common; bedding surfaces wavy to irregular; laminations of silty lmst or limy siltstone common.
Most of sandstone forms inaccessible cliff face. Troughs show transport to the SW, no apparent reversal of transport directions. Sandstone unit is laterally persistant and contains an extensive high relief scour surface that is best observed from across Animas Valley.
Clay ripup clasts up to 14 cm common near base of sandstone but decrease rapidly in abundance upward.
Laterally discontinuous clay drapes above HCS? beds.
Sedimentary structures not apparent in upper part of unit. In lower part of sandstone unit thin siltstone beds overlie sandstone beds; sharp contacts between beds.
Ss beds commonly separated by VTH-TH siltstone or mudstone beds.
Wavy to irregular bedding surfaces in carb-onate unit.
Locally TH-M beds of siltstone between carbonate beds; bedding surfaces of carbonate irregular to wavy. Fossils rare in micrite beds.
Carbonate contains interbeds of siltstone.



GROUP
FORMATION
DEP ENV
REL SL
H L
COLOR
ACCESS.
CARB FABRIC
CONTACT TYPE
BEDDING THICKNESS
LITHOLOGY
GRAIN SIZE
P C M F VF S C
FOOTAGE
FT
M
SED STRUCT
RESISTANCE TO WEATHER
SAMPLES AND PALEOCURRENTS
COMMENTS
figure 4, p. 16
HERMOSA
HONAKER TRAIL EQUIVALENT
M
AL
DF-PD
AL-DP
LG
BBl
YG
LGrG
DG
GrG& MG
GrG
M F
MF
AM
M
P
X?
X?
S
S
Sl
Sl
S
S S G
Sl
C
?
TH-VTH
M-TK
TK-VTK
?
M-TK
M-TK &loc VTH
?
?
M
TH-VTH
M-TH
M
2160
2140
2120
2100
2080
2060
650
640
630
SEG E
SEG D
PH91KF73
PH91KF72
PH91KF71
n=13
235°
PH91KF70
PH91KF69
PH91KF68
253°
n=3
Carbonate nodules common in sandstone.
Malachite and azurite mineralized fractures within sandstone.
Pebbles scattered, same composition but less abundant than below.
Pebbles concentrated at base of trough cross sets.
Pebbles localized in lenses or pods and composed of quartz, feldspar, granite, ss, and sh; pebbles up to 10 cm.
Pebbles average 2 cm but as large as 7 cm, and are scattered within ss.
Scattered rounded pebbles up to 3 cm, sh and lmst ripup clasts to 10 cm.
Pebbly, coarse-grained sandstone sequence is Wengerd and Matheny's (1958) "Grit Bed".
Local lenticular to laterally continuous lams of mdst or slst common between ss beds; shap contacts between ss beds; local scour and fill and sigmoidal? beds.


GROUP
FORMATION
DEP ENV
REL SL
H L
COLOR
ACCESS.
CARB FABRIC
CONTACT TYPE
BEDDING THICKNESS
LITHOLOGY
GRAIN SIZE
P C M F VF S C
FOOTAGE
FT
M
SED STRUCT
RESISTANCE TO WEATHER
SAMPLES AND PALEOCURRENTS
COMMENTS
figure 4, p. 17
HERMOSA
HONAKER TRAIL EQUIVALENT
T-DP
SM-T
M
BG
LOG
GYGr
GYGr
GR
BG
GR
B
DG
BBI
DG
BBI
DG
AM
AM
AF
AM
AM
P-W
X?
P
P
P-G
W-P
W
G&M
C
C
SI
G
G
G
G
S
G
C
G
S?
S
VTH-TH
TH-VTH
TH
M
TK
VTH
TH
M-TH
M
M-TH
M
M?
VTH
?
M-TK
TK
TH
VTH
M-TH
TH
TH
VTH
TH
2260
2240
2220
2200
2180
2160
690
680
670
660
n=8
176°
PH91KF80
PH91KF79
PH91KF78
PH91KF77
PH91KF76
PH91KF74
PH91KF75
About 2 ft covered interval below siltstone beds.
Possible laterally extensive erosion surface at about 2243 ft.
Abundant flat shale ripup clasts along bedding planes.
Nodules 2-10 cm in diameter, fossil abun-dance increases upward, rizoliths? in middle part of unit.
Possible rizoliths? at top of unit, size of nodules decreases upwards.
Nodules interbedded with slst at base of shaly limestone unit.
Limestone bedding surfaces slightly wavy to flat; unit has sharp top, but lowest part of overlying clastic unit covered.
Local chert nodules in shaly limestone unit.
Nodular lmst is interbedded with calcareous mudstone and sitstone.

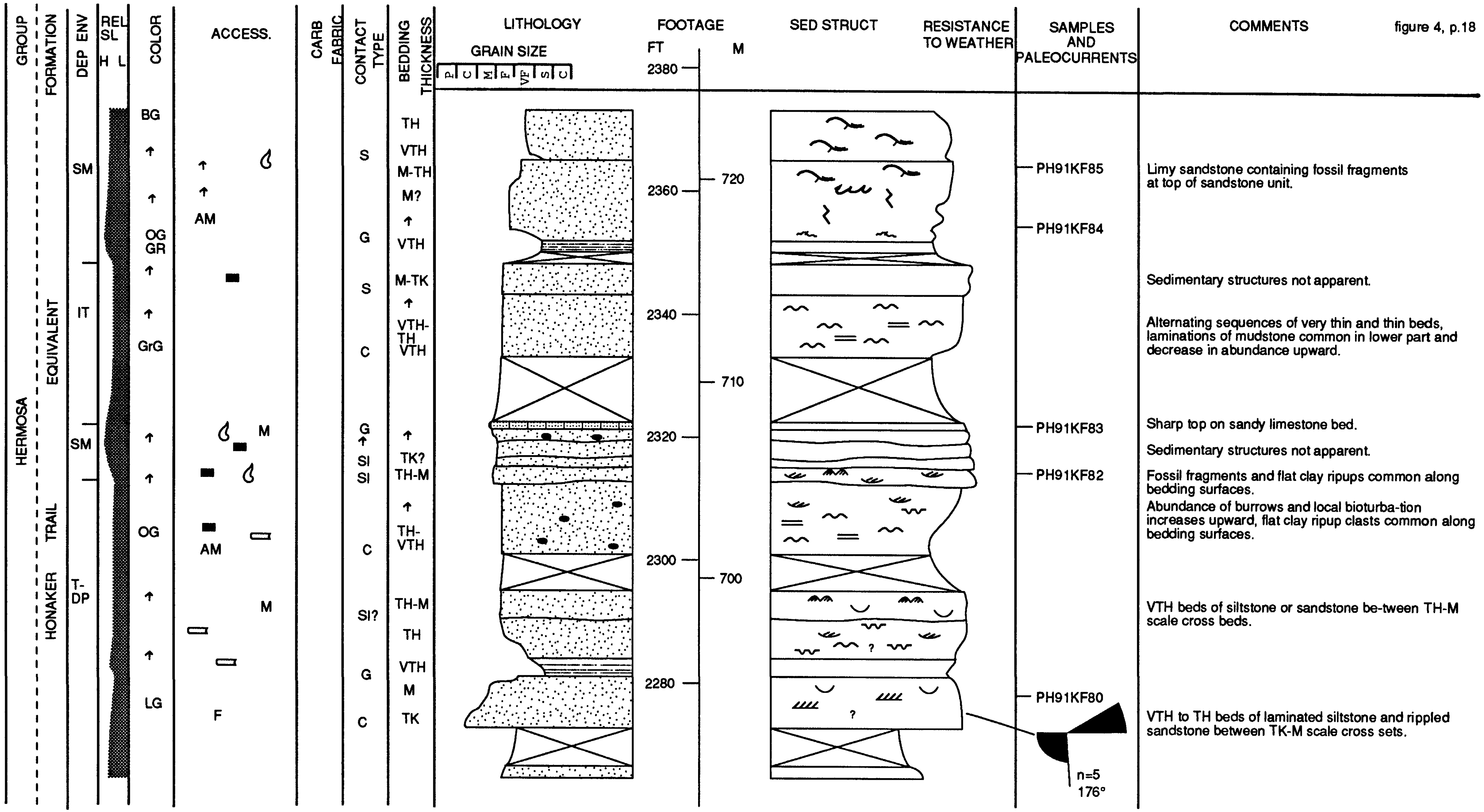
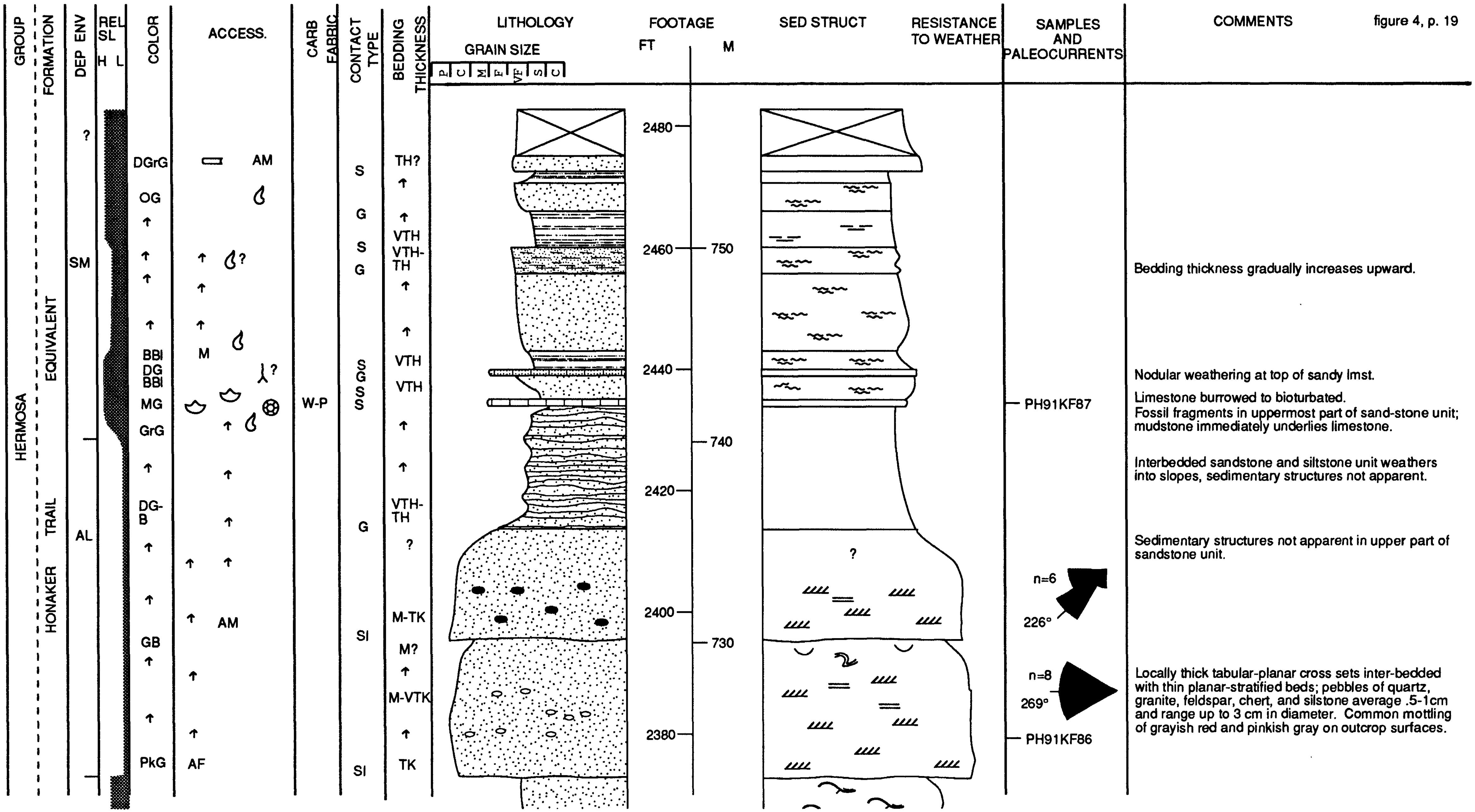
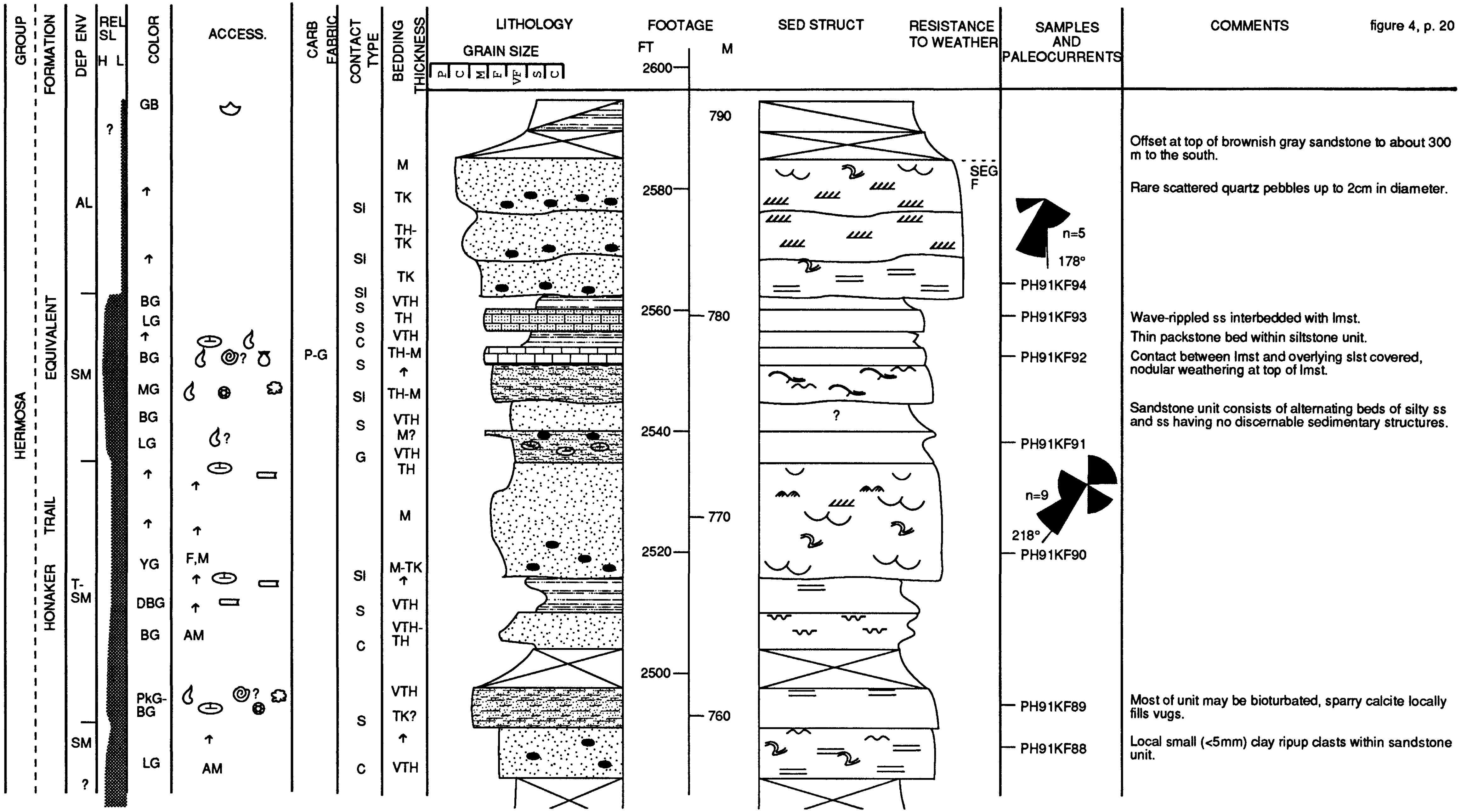
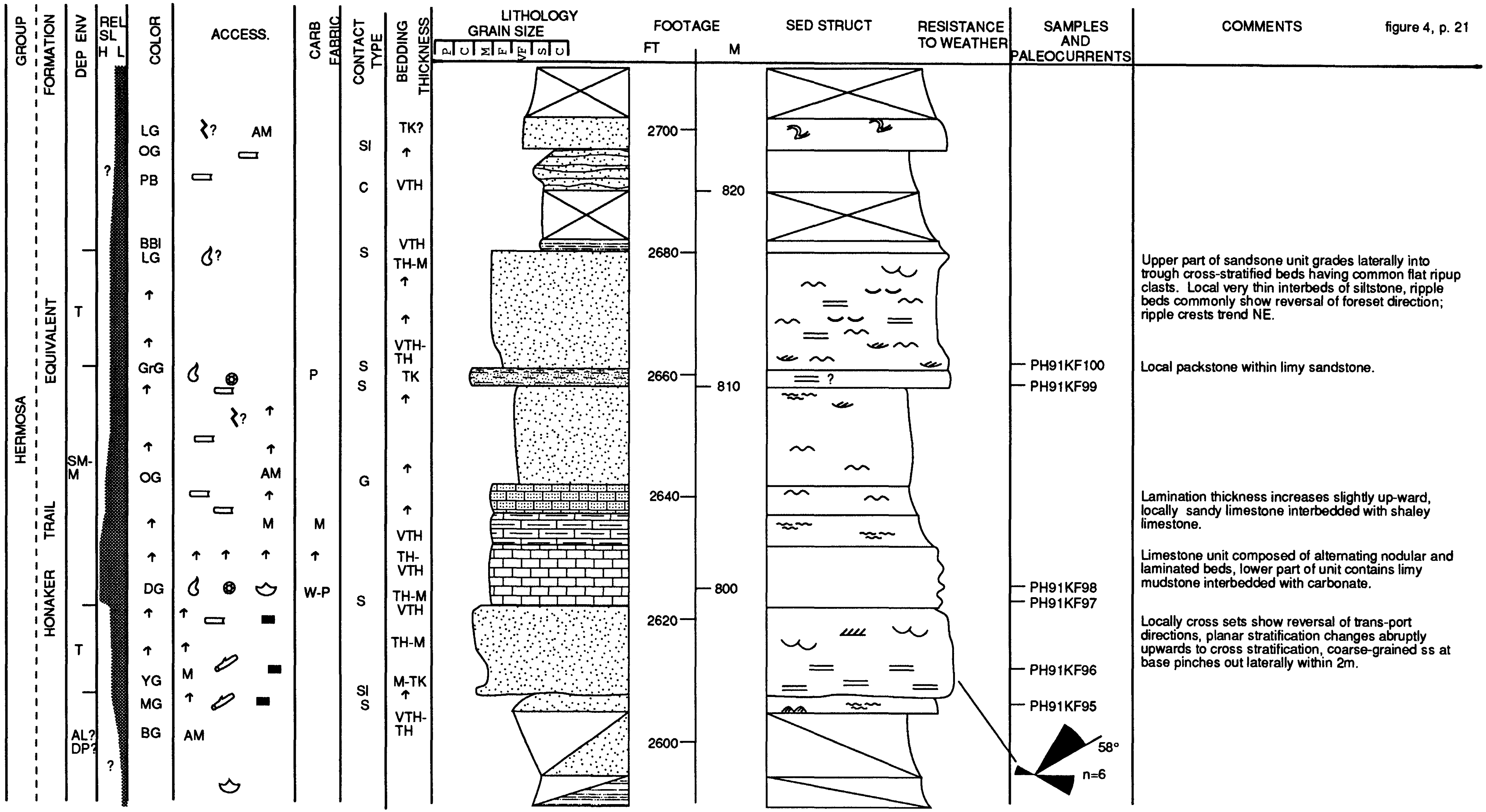
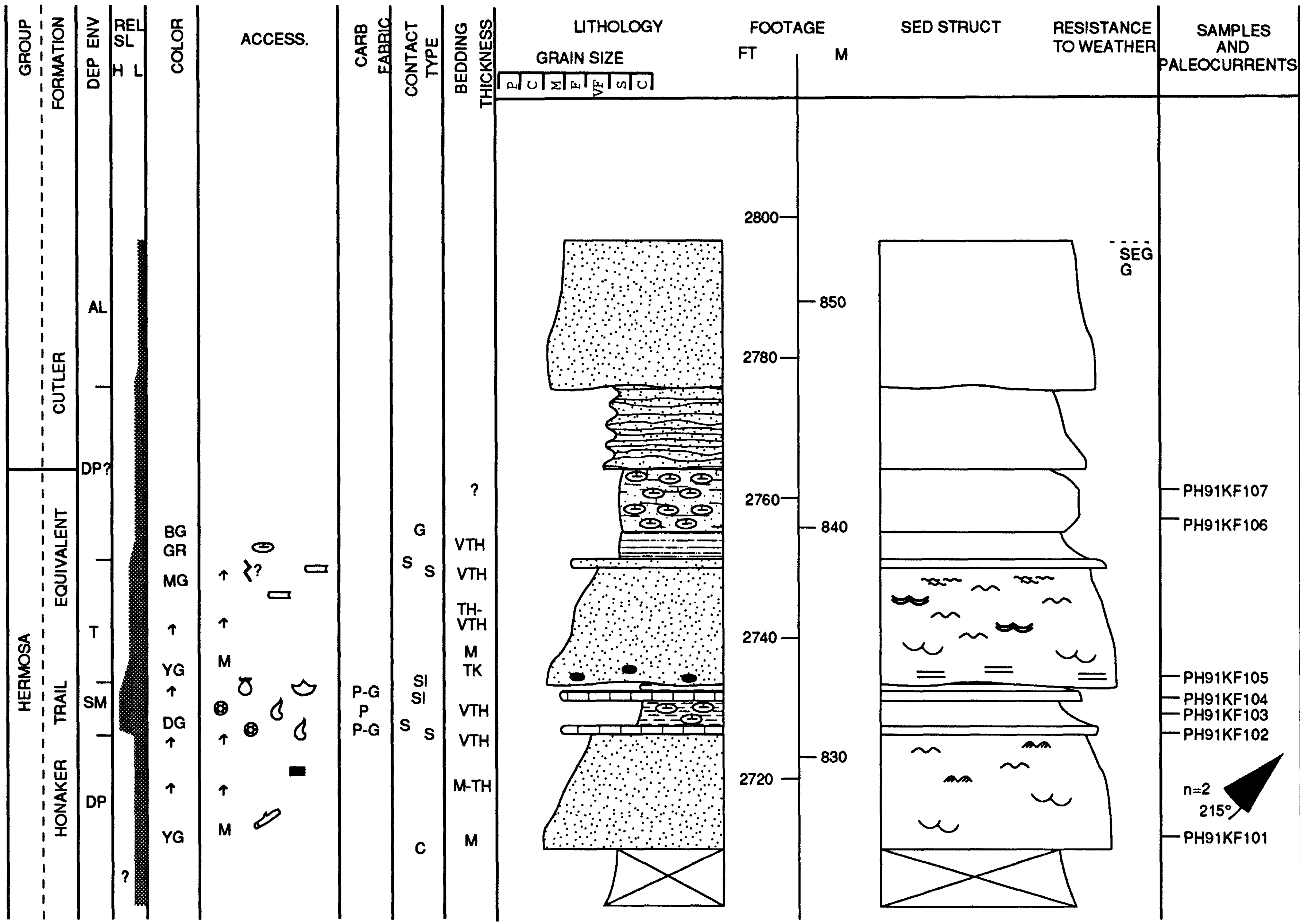

GROUP
FORMATION
DEP ENV
REL SL
H L
COLOR
ACCESS.
CARB FABRIC
CONTACT TYPE
BEDDING THICKNESS
LITHOLOGY
GRAIN SIZE
P C M F VF S C
FOOTAGE
FT
M
SED STRUCT
RESISTANCE TO WEATHER
SAMPLES AND PALEOCURRENTS
COMMENTS
figure 4, p.18
HERMOSA
HONAKER TRAIL EQUIVALENT
SM
IT
SM
T-DP
BG
OG GR
GrG
OG
LG
AM
AM
M
M
F
S
G
S
C
G
SI
SI
C
SI?
G
C
TH
VTH
M-TH
M?
VTH
M-TK
VTH-TH
VTH
TK?
TH-M
TH-VTH
TH-M
TH
VTH
M
TK
2380
2360
2340
2320
2300
2280
720
710
700
PH91KF85
PH91KF84
PH91KF83
PH91KF82
PH91KF80
n=5
176°
Limy sandstone containing fossil fragments at top of sandstone unit.
Sedimentary structures not apparent.
Alternating sequences of very thin and thin beds, laminations of mudstone common in lower part and decrease in abundance upward.
Sharp top on sandy limestone bed.
Sedimentary structures not apparent.
Fossil fragments and flat clay ripups common along bedding surfaces.
Abundance of burrows and local bioturba-tion increases upward, flat clay ripup clasts common along bedding surfaces.
VTH beds of siltstone or sandstone be-tween TH-M scale cross beds.
VTH to TH beds of laminated siltstone and rippled sandstone between TK-M scale cross sets.

figure 4, p. 19


GROUP
FORMATION
DEP ENV
REL SL
H L
COLOR
ACCESS.
CARB FABRIC
CONTACT TYPE
BEDDING THICKNESS
LITHOLOGY
GRAIN SIZE
P C M F VF S C
FOOTAGE
FT
M
SED STRUCT
RESISTANCE TO WEATHER
SAMPLES AND PALEOCURRENTS
COMMENTS
HERMOSA
HONAKER TRAIL EQUIVALENT
SM
AL
?
DGrG
OG
BBl
DG
BBl
MG
GrG
DG-B
GB
PkG
AM
M
?
AM
AF
W-P
S
G
S
G
S
G
S
S
G
Sl
Sl
TH?
VTH
VTH-TH
VTH
VTH
VTH-TH
?
M-TK
M?
M-VTK
TK
2480
2460
2440
2420
2400
2380
750
740
730
?
PH91KF87
n=6
226°
n=8
269°
PH91KF86
Bedding thickness gradually increases upward.
Nodular weathering at top of sandy lmst.
Limestone burrowed to bioturbated.
Fossil fragments in uppermost part of sand-stone unit; mudstone immediately underlies limestone.
Interbedded sandstone and siltstone unit weathers into slopes, sedimentary structures not apparent.
Sedimentary structures not apparent in upper part of sandstone unit.
Locally thick tabular-planar cross sets inter-bedded with thin planar-stratified beds; pebbles of quartz, granite, feldspar, chert, and silstone average .5-1cm and range up to 3 cm in diameter. Common mottling of grayish red and pinkish gray on outcrop surfaces.


GROUP
FORMATION
DEP ENV
REL SL
H L
COLOR
ACCESS.
CARB FABRIC
CONTACT TYPE
BEDDING THICKNESS
LITHOLOGY
GRAIN SIZE
P C M F VF S C
FOOTAGE
FT
M
SED STRUCT
RESISTANCE TO WEATHER
SAMPLES AND PALEOCURRENTS
COMMENTS
figure 4, p. 20
HERMOSA
HONAKER TRAIL EQUIVALENT
AL
SM
T-SM
SM
?
GB
BG
LG
BG
MG
BG
LG
YG
DBG
BG
PkG-BG
LG
F,M
AM
AM
P-G
SI
SI
SI
S
S
C
S
SI
S
G
SI
S
C
S
C
M
TK
TH-TK
TK
VTH
TH
VTH
TH-M
TH-M
VTH
M?
VTH
TH
M
M-TK
VTH
VTH-TH
VTH
TK?
VTH
2600
2580
2560
2540
2520
2500
790
780
770
760
SEG F
n=5
178°
n=9
218°
PH91KF94
PH91KF93
PH91KF92
PH91KF91
PH91KF90
PH91KF89
PH91KF88
Offset at top of brownish gray sandstone to about 300 m to the south.
Rare scattered quartz pebbles up to 2cm in diameter.
Wave-rippled ss interbedded with lmst.
Thin packstone bed within siltstone unit.
Contact between lmst and overlying slst covered, nodular weathering at top of lmst.
Sandstone unit consists of alternating beds of silty ss and ss having no discernable sedimentary structures.
Most of unit may be bioturbated, sparry calcite locally fills vugs.
Local small (<5mm) clay ripup clasts within sandstone unit.


GROUP
FORMATION
DEP ENV
REL SL
H L
COLOR
ACCESS.
CARB FABRIC
CONTACT TYPE
BEDDING THICKNESS
LITHOLOGY
GRAIN SIZE
P C M F VF S C
FOOTAGE
FT
M
SED STRUCT
RESISTANCE TO WEATHER
SAMPLES AND PALEOCURRENTS
COMMENTS
figure 4, p. 21
HERMOSA
HONAKER TRAIL EQUIVALENT
T
SM-M
AL? DP?
LG
OG
PB
BBI LG
GrG
OG
DG
YG
MG
BG
AM
M
P
W-P
SI
C
S
G
TK?
VTH
TH-M
VTH-TH
TK
TH-VTH
TH-M VTH
M-TK
2700
2680
2660
2640
2620
2600
820
810
800
PH91KF100
PH91KF99
PH91KF98
PH91KF97
PH91KF96
PH91KF95
58°
n=6
Upper part of sandsone unit grades laterally into trough cross-stratified beds having common flat ripup clasts. Local very thin interbeds of siltstone, ripple beds commonly show reversal of foreset direction; ripple crests trend NE.
Local packstone within limy sandstone.
Lamination thickness increases slightly up-ward, locally sandy limestone interbedded with shaley limestone.
Limestone unit composed of alternating nodular and laminated beds, lower part of unit contains limy mudstone interbedded with carbonate.
Locally cross sets show reversal of trans-port directions, planar stratification changes abruptly upwards to cross stratification, coarse-grained ss at base pinches out laterally within 2m.



COMMENTS

figure 4, p. 22

Top of Hermosa Formation placed at 2765 ft. Carbonate horizons within overlying Cutler Formation appear to be of pedogenic origin. Units within Cutler are characteristicly grayish red to reddish brown and of entirely continental origin.

Sandy siltstone unit composed of amalgamated carbonate nodules that are of probable pedogenic origin, risoliths? present.

Carbonate nodules in siltstone may be of pedogenic origin.

Clay drapes occur above most sandstone beds, local very thin beds of siltstone or mudstone interbedded with sandstone, lower .5 m of unit contains abundant flat ripup clasts up to 6 cm in diameter.

Packstone nodules within shale are 10-15 cm in diameter and very fossiliferous.

Uppermost part of sandstone unit contains local interbeds of very thinly bedded siltstone and mudstone.

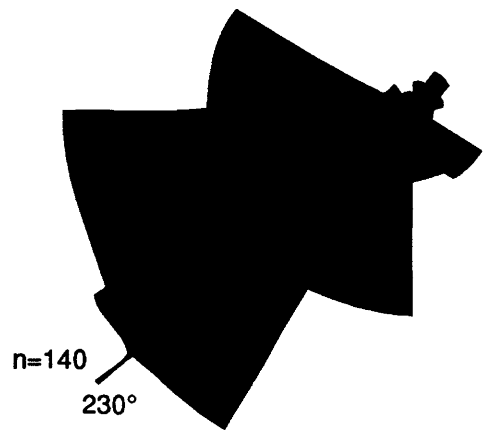


Figure 5. Rose diagram showing combined data from the entire Hermosa Group at Hermosa Mountain. Average mean vector is 230°; N is the number of measurements.