Pattison, S.A.J., 2019, High resolution linkage of channel-coastal plain and shallow marine facies belts, Desert Member to Lower Castlegate Sandstone stratigraphic interval, Book Cliffs, Utah-Colorado, USA: GSA Bulletin, https://doi.org/10.1130/B35094.1.

Data Repository

Figure DR1. High resolution outcrop correlation panel. West-to-east oriented cross section includes 42 measured sections, from Woodside/Price River Canyon in east-central Utah (section #4) to West Salt Creek in western Colorado (section #45). A lower datum is used, which is the top of the Grassy Member. Measured sections are projected onto a depositionally-dip-oriented (W14°N to E14°S) line and positioned accordingly (Fig. 1). Entire panel covers ≈ 110 km of depositionally-dip-oriented outcrop. Most key surfaces and rock packages have been walked, sampled and photographed at and between all measured sections. Thicknesses and lateral extentof channels are mostly true to scale, although some simplification was necessary in converting three-dimensional architectural data into a two-dimensional cross sectional plot. Sections 1 to 3 (Castle Gate, Soldier Creek Canyon, Sunnyside) are not included because of the similar and unchanging stratigraphy, coupled with the long distances between these locations. GPS1-GPS4 (Grassy Member parasequences), D1-D11 (Desert Member parasequences), C1-C6 (Lower Castlegate Sandstone parasequences), FAF (Flat and Foreshore), WC (White Cap), MFS (Maximum Flooding Surface), CH (Channel).

Figures DR2 to DR46. Measured sections 1 to 45.

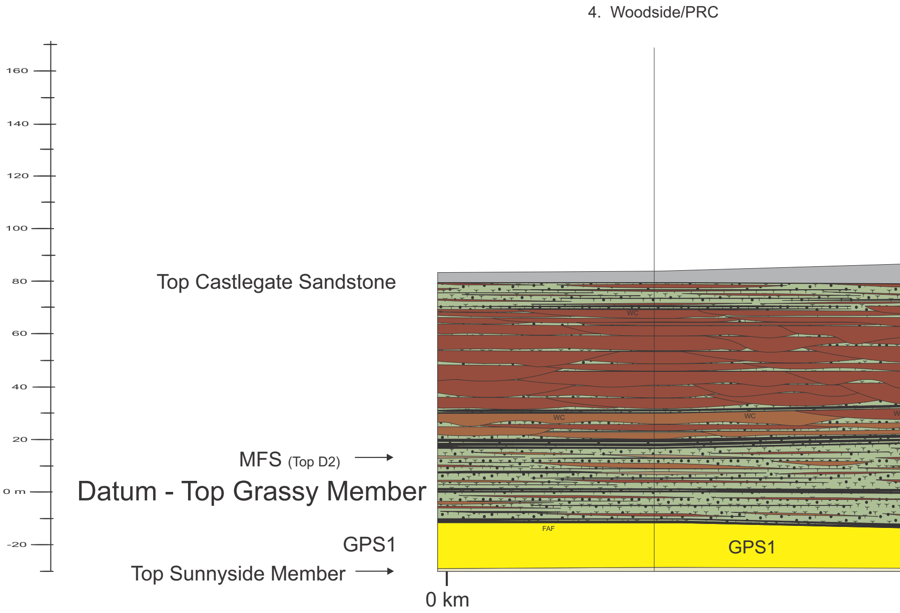
Figure DR47. Legend for measured sections.

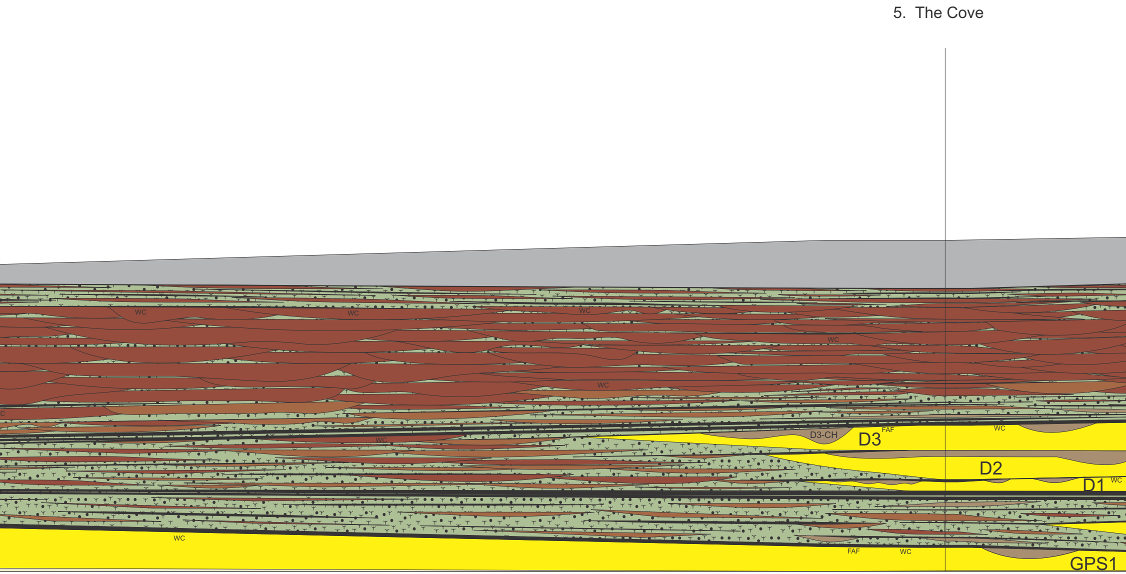
Figure DR48. Basic sequence stratigraphy. (A) Conventional sequence stratigraphic model of the Desert (D) Member to Lower Castlegate (C) Sandstone (C.Ss.) interval (Van Wagoner et al., 1990; Van Wagoner 1991, 1995). Third-order sequence boundaries (D-SB, C-SB) separate the terrestrial and shallow marine facies belts. HST (Highstand Systems Tract, LST (Lowstand Systems Tract), TST (Transgressive Systems Tract), G-HSS (Grassy Highstand Sequence Set), LSS (Lowstand Sequence Set). (B) Alternative sequence stratigraphic model (this study). Time lines connect the terrestrial and shallow marine facies belts (i.e. thick coal zones and flooding surfaces). Shoreface-incised channels are tidal-estuarine-fluvial and occur as discrete incisions in most Desert-Castlegate parasequences. Similar shoreface-incised channels exists in other members of the Blackhawk Formation.

Table DR1. Facies descriptions and interpretations. Eight shallow marine facies (1A to 1H), ten channel facies (2A to 2J), and six coastal plain facies (3A to 3F) identified throughout the Desert Member to Lower Castlegate Sandstone stratigraphic interval.

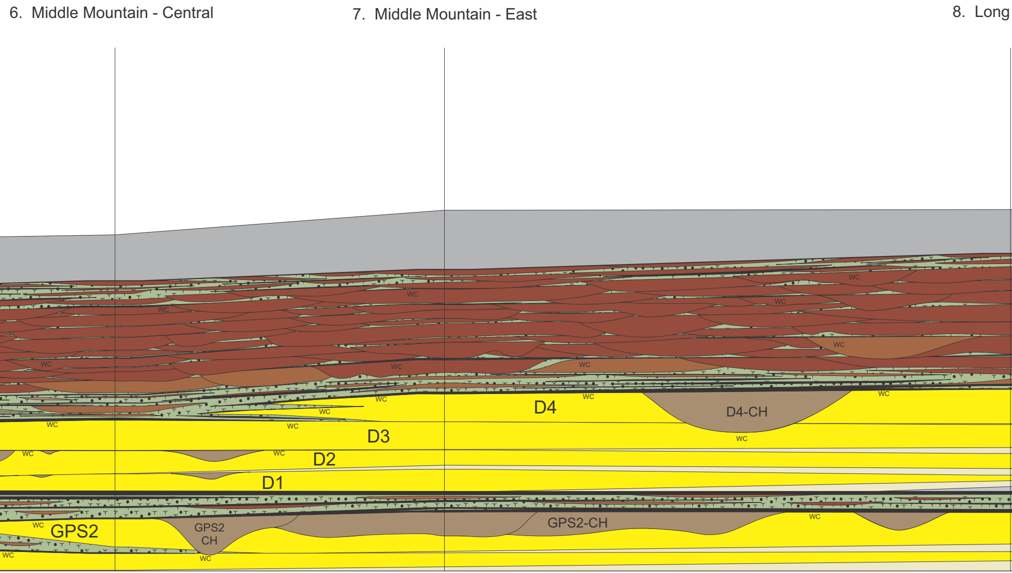
Table DR2. Paleocurrent data from Lower Castlegate Sandstone channels (i.e. vector mean, number).

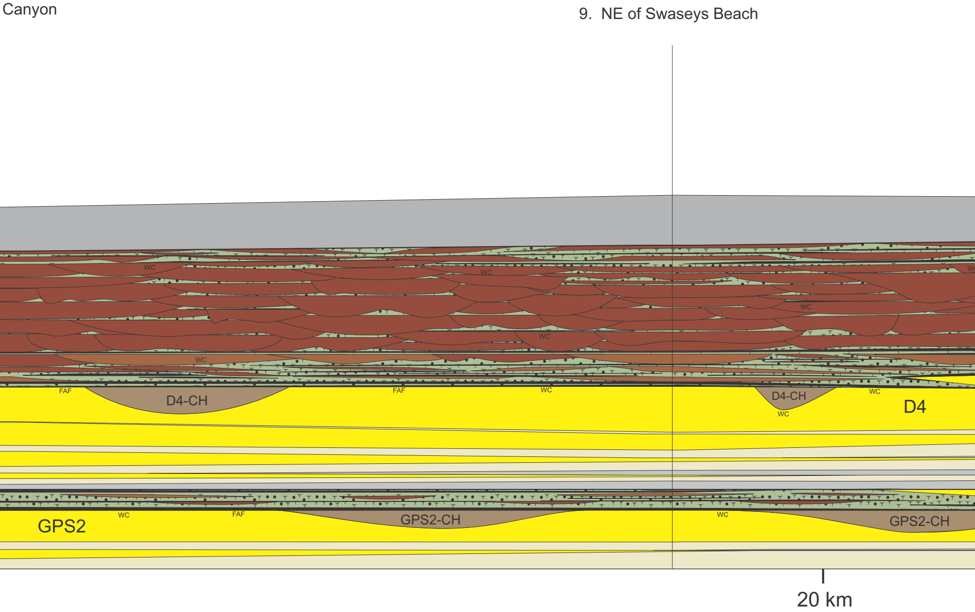
Book Cliffs Field Trip Guidebook


4. Woodside/PRC
160
140
120
100
80
60
40
20
0 m
-20
Top Castlegate Sandstone
MFS (Top D2)
Datum - Top Grassy Member
GPS1
Top Sunnyside Member
WC
WC
WC
FAF
GPS1
0 km

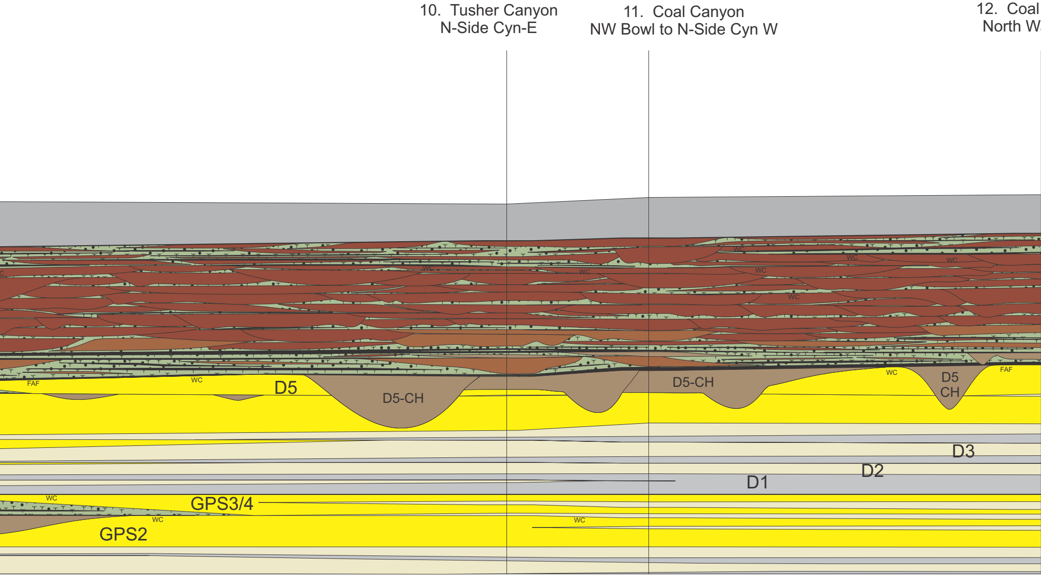


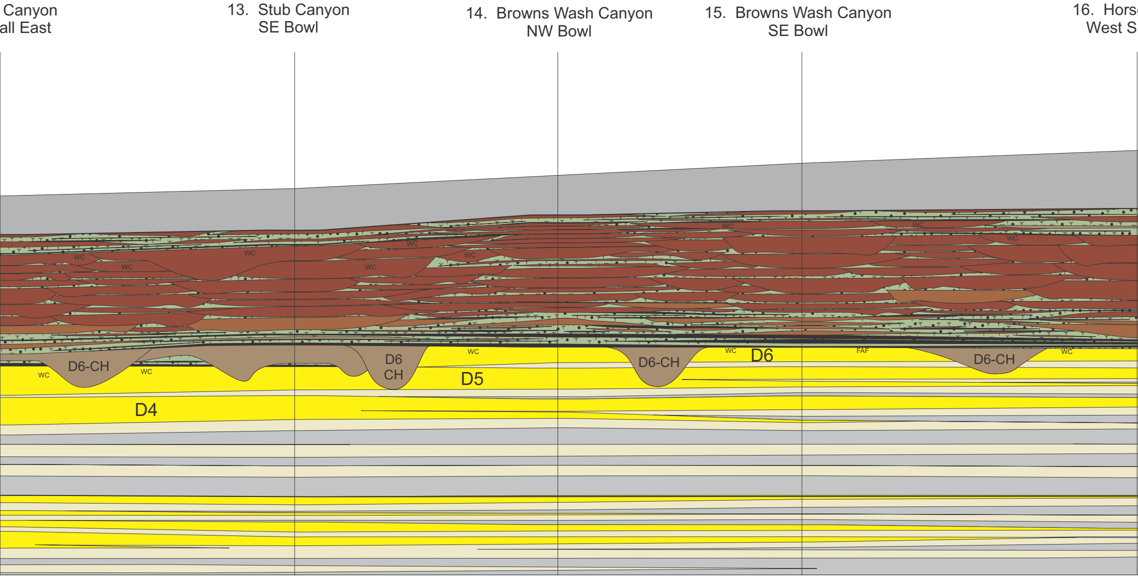
5. The Cove
WC
WC
WC
WC
WC
C
WC
D3-CH
D3
FAF
WC
D2
D1
WC
WC
FAF
WC
GPS1

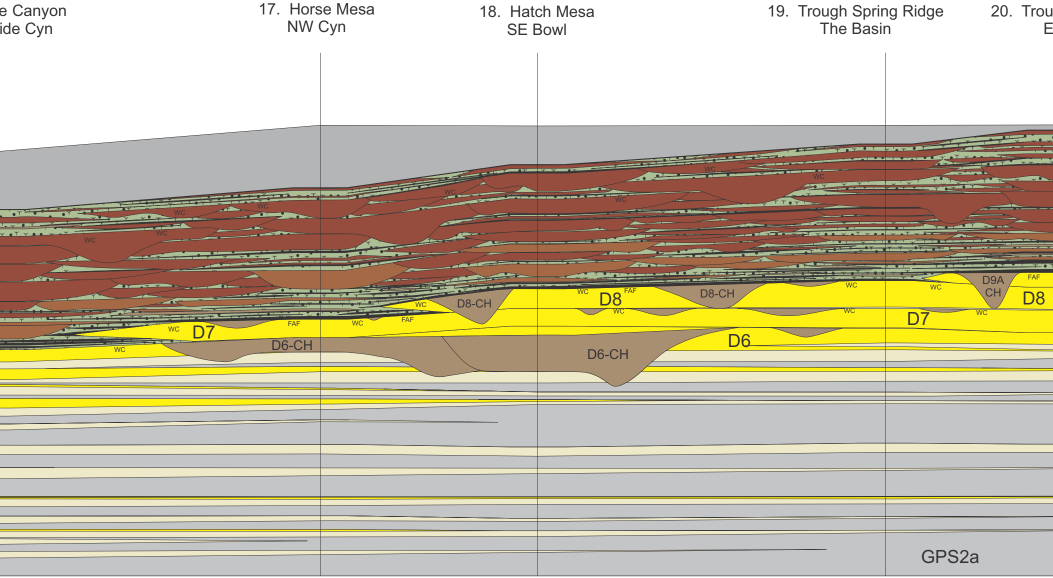

6. Middle Mountain - Central
7. Middle Mountain - East
8. Long
WC
WC
WC
WC
WC
WC
WC
WC
WC
WC
WC
WC
D4
D4-CH
WC
WC
WC
D3
WC
WC
D2
D1
WC
GPS2
GPS2
CH
GPS2-CH
WC
WC
WC

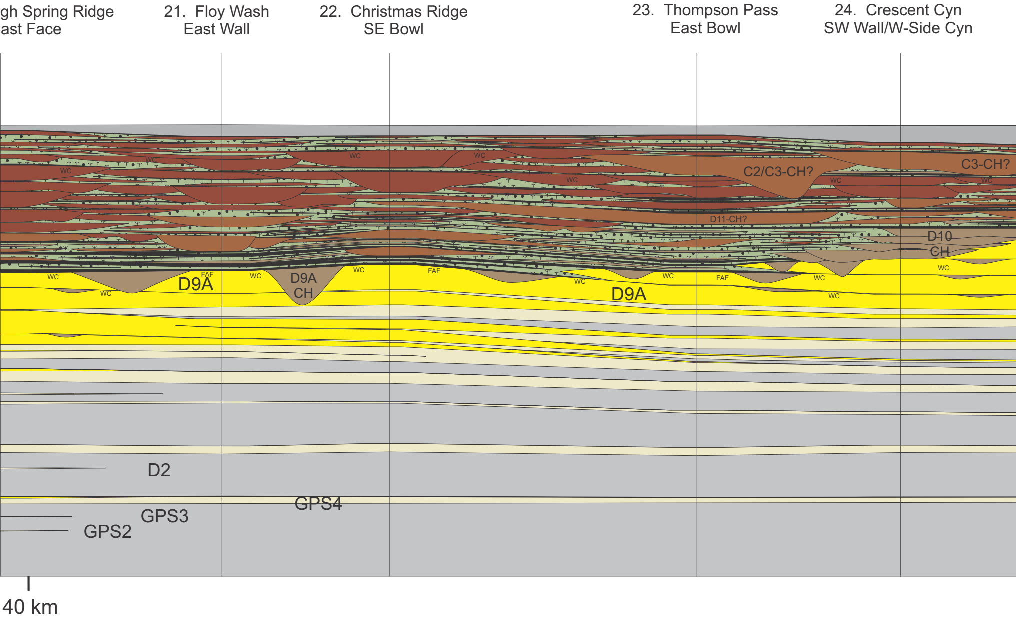


Canyon
9. NE of Swaseys Beach
WC
WC
WC
WC
WC
FAF
D4-CH
FAF
WC
D4-CH
WC
WC
D4
GPS2
WC
FAF
GPS2-CH
WC
GPS2-CH
20 km

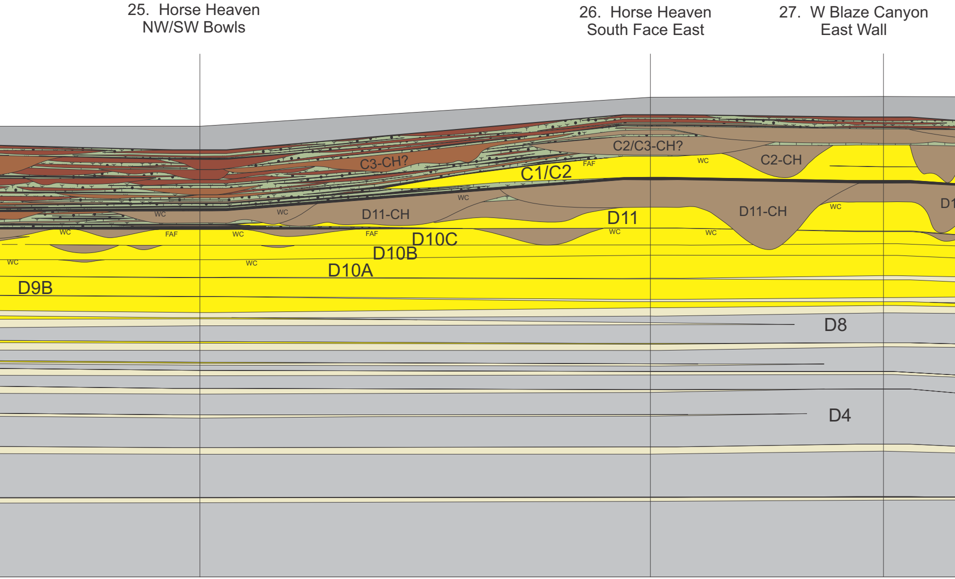

10. Tusher Canyon
N-Side Cyn-E
11. Coal Canyon
NW Bowl to N-Side Cyn W
12. Coal
North W
WC
WC
WC
WC
WC
WC
WC
WC
FAF
WC
D5
D5-CH
D5-CH
WC
D5
CH
FAF
D3
D2
D1
WC
GPS3/4
WC
GPS2
WC


Canyon
all East
13. Stub Canyon
SE Bowl
14. Browns Wash Canyon
NW Bowl
15. Browns Wash Canyon
SE Bowl
16. Hors
West S
WC
D6-CH
D6
CH
D5
D6
FAF
D4


e Canyon
ide Cyn
17. Horse Mesa
NW Cyn
18. Hatch Mesa
SE Bowl
19. Trough Spring Ridge
The Basin
20. Trou
E
WC
WC
WC
WC
WC
WC
WC
WC
WC
WC
D8
FAF
D8-CH
D9A
CH
D8
D8-CH
WC
FAF
WC
FAF
WC
WC
D7
D7
WC
D6-CH
D6-CH
D6
WC
GPS2a



gh Spring Ridge
ast Face
21. Floy Wash
East Wall
22. Christmas Ridge
SE Bowl
23. Thompson Pass
East Bowl
24. Crescent Cyn
SW Wall/W-Side Cyn
C2/C3-CH?
C3-CH?
D11-CH?
D10
CH
D9A
D9A
CH
D9A
FAF
WC
D2
GPS3
GPS2
GPS4
40 km


25. Horse Heaven
NW/SW Bowls
26. Horse Heaven
South Face East
27. W Blaze Canyon
East Wall
C3-CH?
C2/C3-CH?
C2-CH
C1/C2
FAF
WC
D11-CH
D11
D1
D10C
D10B
D10A
D9B
D8
D4

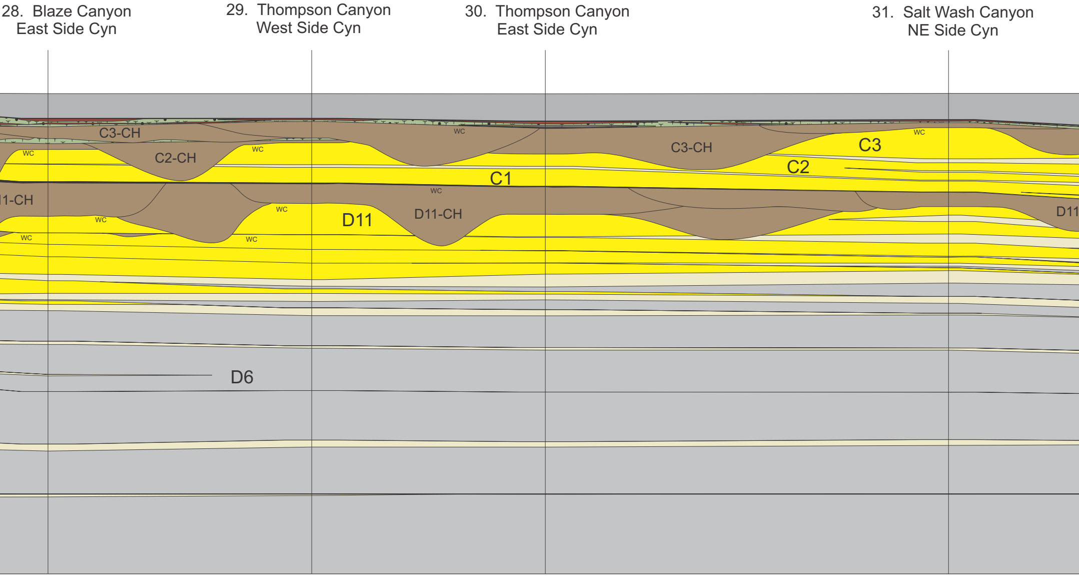
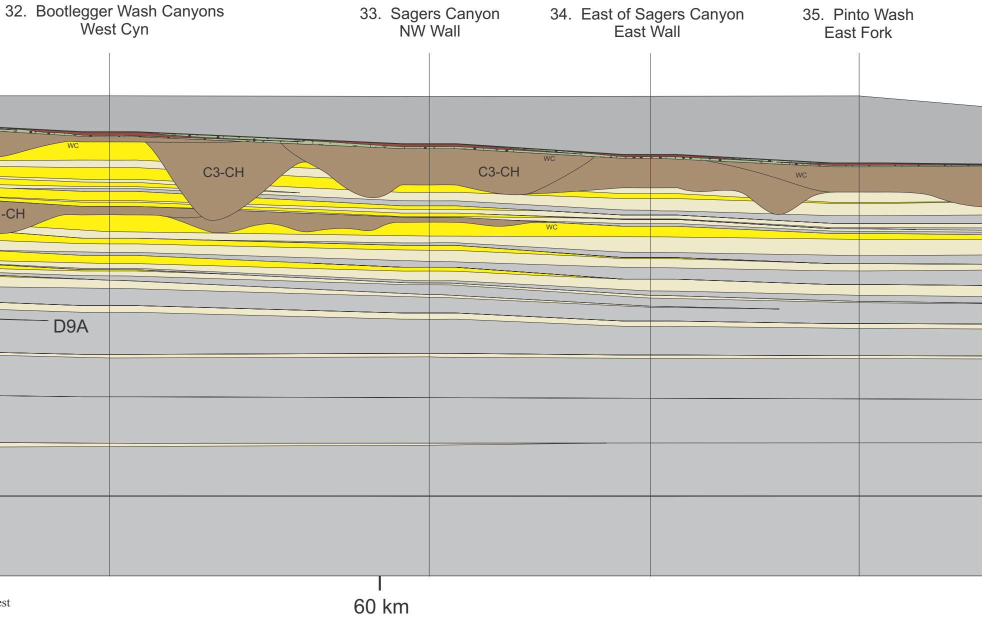
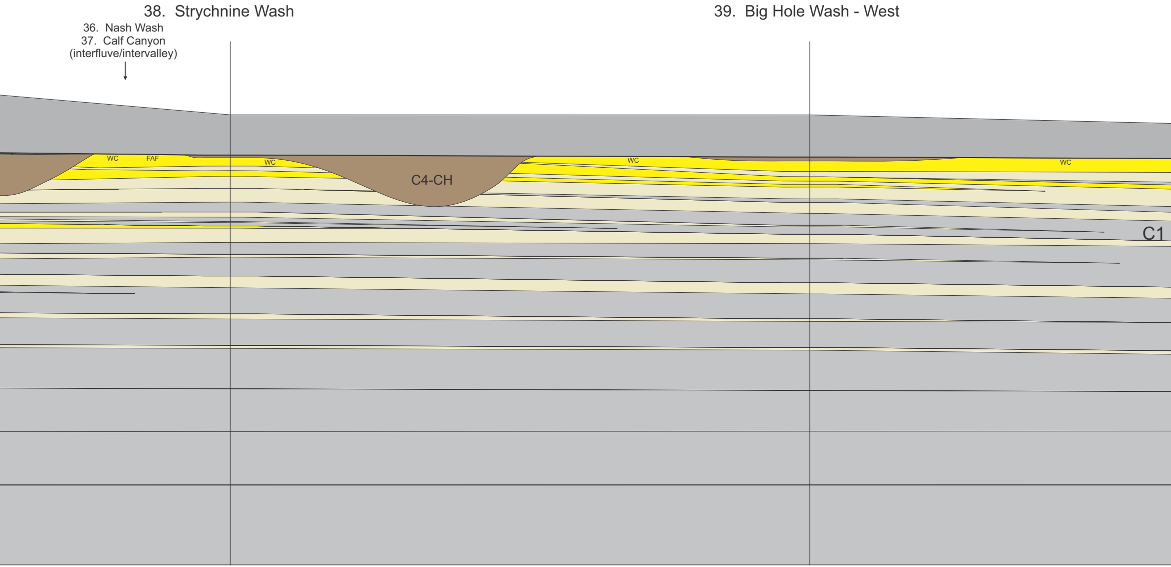
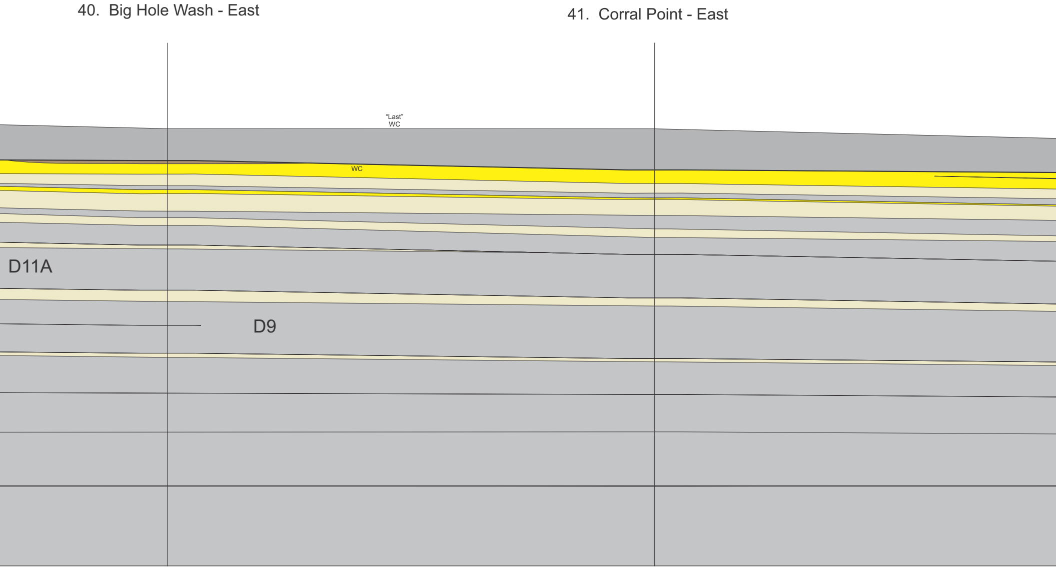
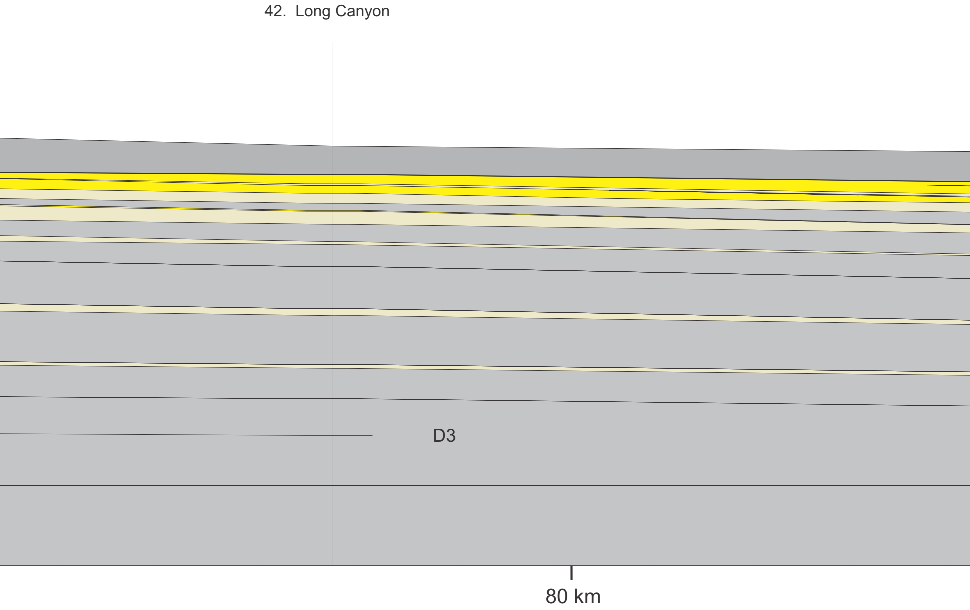

28. Blaze Canyon
East Side Cyn
29. Thompson Canyon
West Side Cyn
30. Thompson Canyon
East Side Cyn
31. Salt Wash Canyon
NE Side Cyn
C3-CH
WC
C2-CH
WC
WC
C3-CH
WC
C3
C2
C1
1-CH
WC
WC
D11
D11-CH
WC
D11
WC
WC
D6

Figure DR1. High resolution outcrop correlation panel. West-to-east oriented cross section includes 42 measured sections, from Woodside/Price River Canyon in east-central Utah (section #4) to We Salt Creek in western Colorado (section #45). A lower datum is used, which is the top of the Grassy Member. Measured sections are projected onto a depositionally-dip-oriented (W14°N to E14°S) line and positioned accordingly (Figure 1). Entire panel covers ≈ 110 km of depositionally-dip-oriented outcrop. Most key surfaces and rock packages have been walked, sampled and photographed at and between all measured sections. Thicknesses and lateral extent of channels are mostly true to scale, although some simplification was necessary in converting three-dimensional architectural data into a two-dimensional cross sectional plot. Sections 1 to 3 (Castle Gate, Soldier Creek Canyon, Sunnyside) are not included because of the similar and unchanging stratigraphy, coupled with the long distances between these locations. GPS1-GPS4 (Grassy Member parasequences), D1-D11 (Desert Member parasequences), C1-C6 (Lower Castlegate Sandstone parasequences), FAF (Flat and Foreshore), WC (White Cap), MFS (Maximum Flooding Surface), CH (Channel).

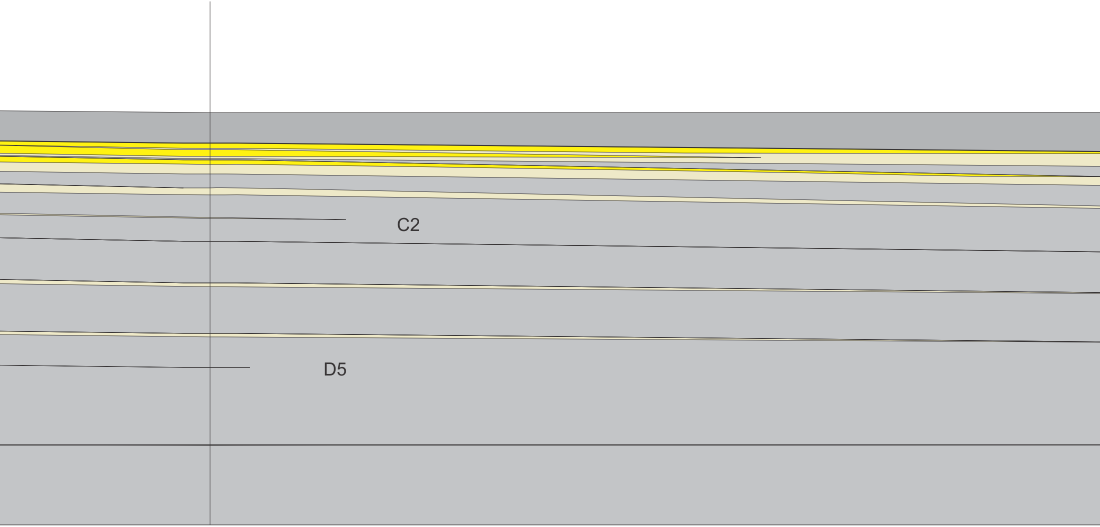

32. Bootlegger Wash Canyons
West Cyn
33. Sagers Canyon
NW Wall
34. East of Sagers Canyon
East Wall
35. Pinto Wash
East Fork
wc
C3-CH
C3-CH
wc
wc
-CH
wc
D9A
est
60 km

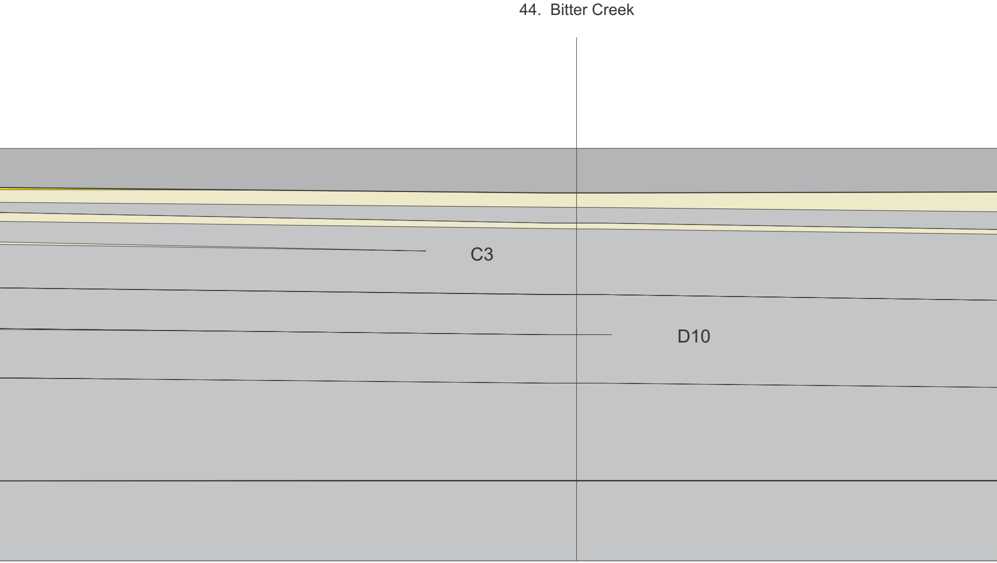

38. Strychnine Wash
39. Big Hole Wash - West
36. Nash Wash
37. Calf Canyon
(interfluve/intervalley)
WC
FAF
WC
C4-CH
WC
WC
C1

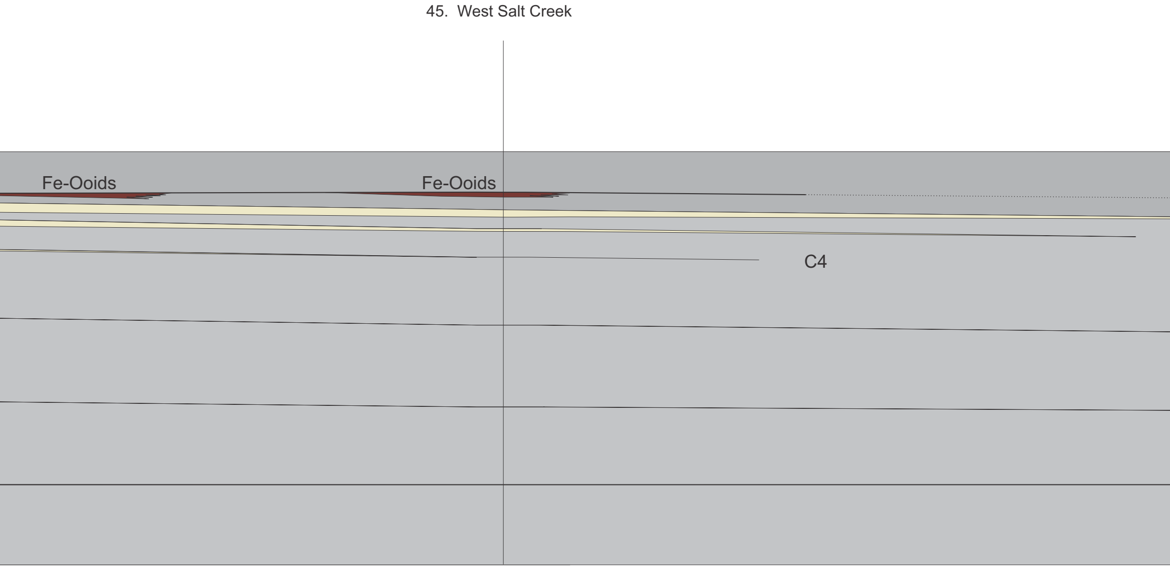

40. Big Hole Wash - East
41. Corral Point - East
"Last"
WC
WC
D11A
D9

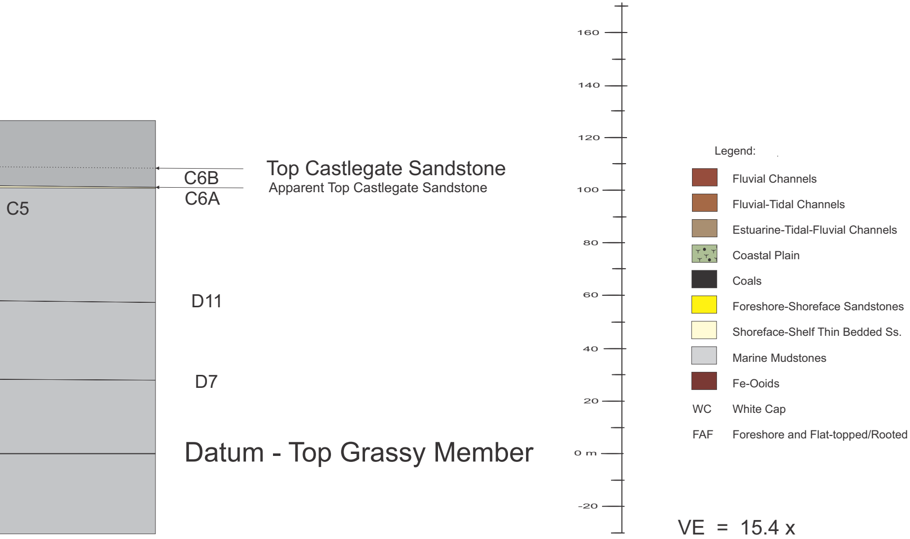

42. Long Canyon
D3
80 km

43. Sulphur Creek




44. Bitter Creek
C3
D10


45. West Salt Creek
Fe-Ooids
Fe-Ooids
C4


Top Castlegate Sandstone
Apparent Top Castlegate Sandstone
C6B
C6A
C5
D11
D7
Datum - Top Grassy Member
160
140
120
100
80
60
40
20
0 m
-20
Legend:
Fluvial Channels
Fluvial-Tidal Channels
Estuarine-Tidal-Fluvial Channels
Coastal Plain
Coals
Foreshore-Shoreface Sandstones
Shoreface-Shelf Thin Bedded Ss.
Marine Mudstones
Fe-Ooids
WC White Cap
FAF Foreshore and Flat-topped/Rooted
VE = 15.4 x

1. Castle Gate

Key Photos: DSCN0182, DSCN01101

Variety of Lithostratigraphic Names:

Price River Formation
(Spieker and Reeside 1925)

Neslen Facies of the P.R.Fm.
(Young 1955)

Bluecastle Tongue of C.Ss.
(Fouch et al. 1983)

Neslen Formation
(Lawton 1986)

Mudstone Member of C.Ss.
(Yoshida et al. 1996)

Upper Castlegate Sandstone
(after Yoshida et al. 1998; Willis 2000; Yoshida 2000; Miall and Arush, 2001a,b)

Middle Member of C.Ss.
(McLaurin and Steel 2000)

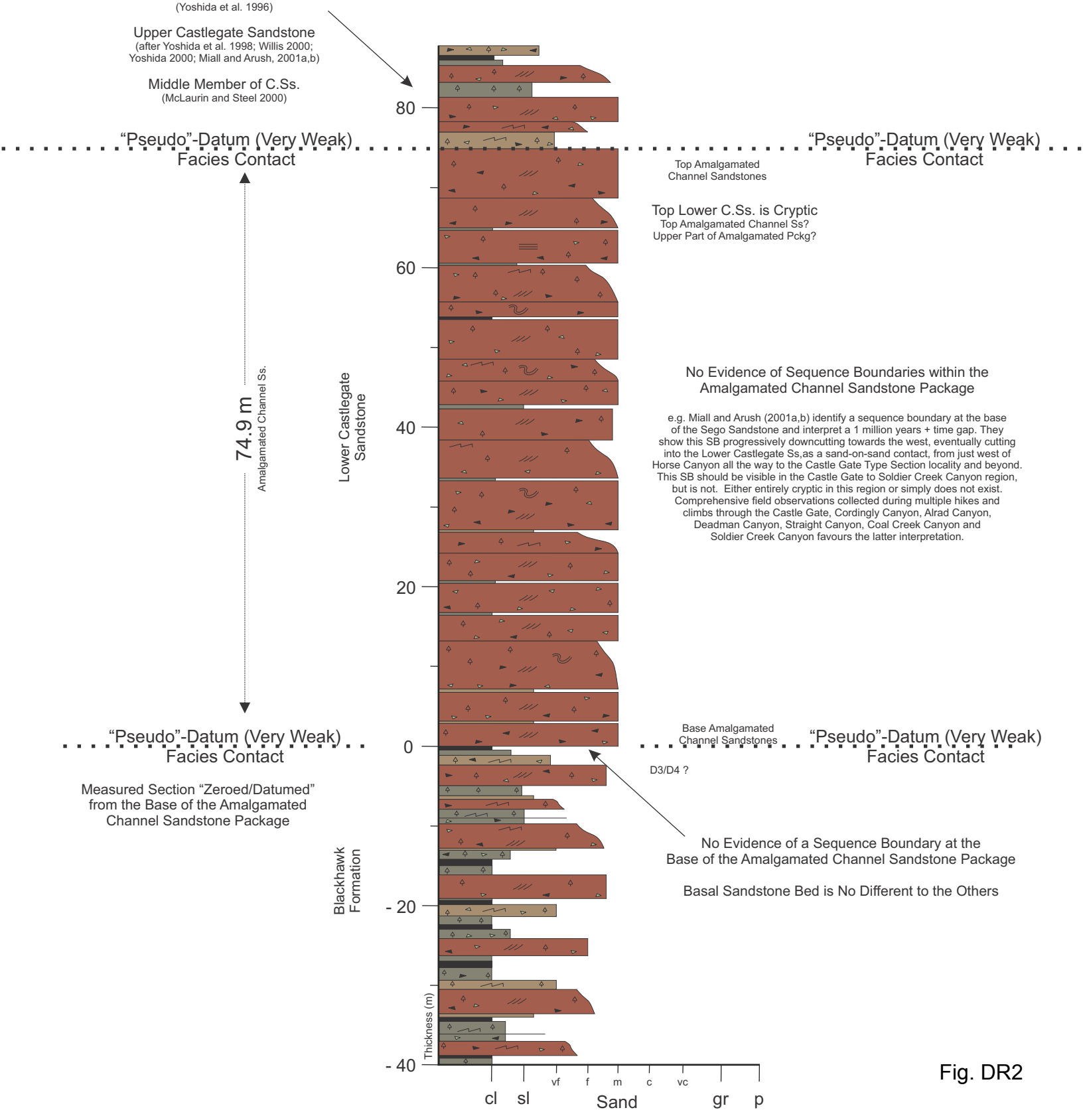


Fig. DR2

2. Soldier Creek Canyon

Key Photos: DSCN0008, DSCN0119

Variety of Lithostratigraphic Names:

Price River Formation
(Spieker and Reeside 1925)

Neslen Facies of the P.R.Fm.
(Young 1955)

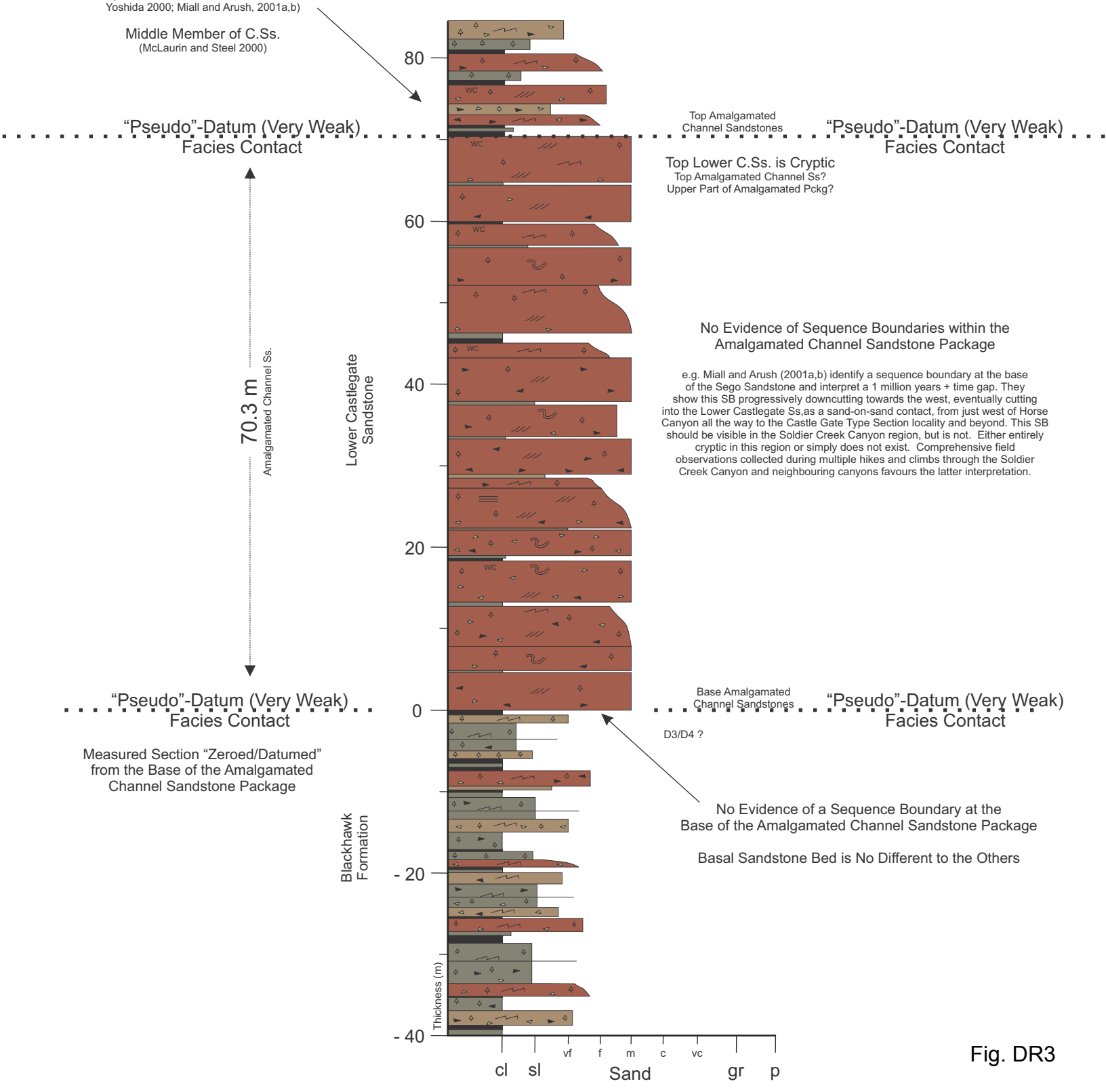
Bluecastle Tongue of C.Ss.
(Fouch et al. 1983)

Neslen Formation
(Lawton 1986)

Mudstone Member of C.Ss.
(Yoshida et al. 1996)

Upper Castlegate Sandstone
(after Yoshida et al. 1998; Willis 2000; Yoshida 2000; Miall and Arush, 2001a,b)

Middle Member of C.Ss.
(McLaurin and Steel 2000)



Top Lower C.Ss. is Cryptic
Top Amalgamated Channel Ss?
Upper Part of Amalgamated Pckg?

No Evidence of Sequence Boundaries within the Amalgamated Channel Sandstone Package

e.g. Miall and Arush (2001a,b) identify a sequence boundary at the base of the Sego Sandstone and interpret a 1 million years + time gap. They show this SB progressively downcutting towards the west, eventually cutting into the Lower Castlegate Ss,as a sand-on-sand contact, from just west of Horse Canyon all the way to the Castle Gate Type Section locality and beyond. This SB should be visible in the Soldier Creek Canyon region, but is not. Either entirely cryptic in this region or simply does not exist. Comprehensive field observations collected during multiple hikes and climbs through the Soldier Creek Canyon and neighbouring canyons favours the latter interpretation.

D3/D4 ?

No Evidence of a Sequence Boundary at the Base of the Amalgamated Channel Sandstone Package

Basal Sandstone Bed is No Different to the Others

Measured Section "Zeroed/Datumed" from the Base of the Amalgamated Channel Sandstone Package

Fig. DR3

3. Sunnyside

Key Photos: DSCN0141, DSCNa0020, DSCNa0025, DSCN0169, DSCNa0008.

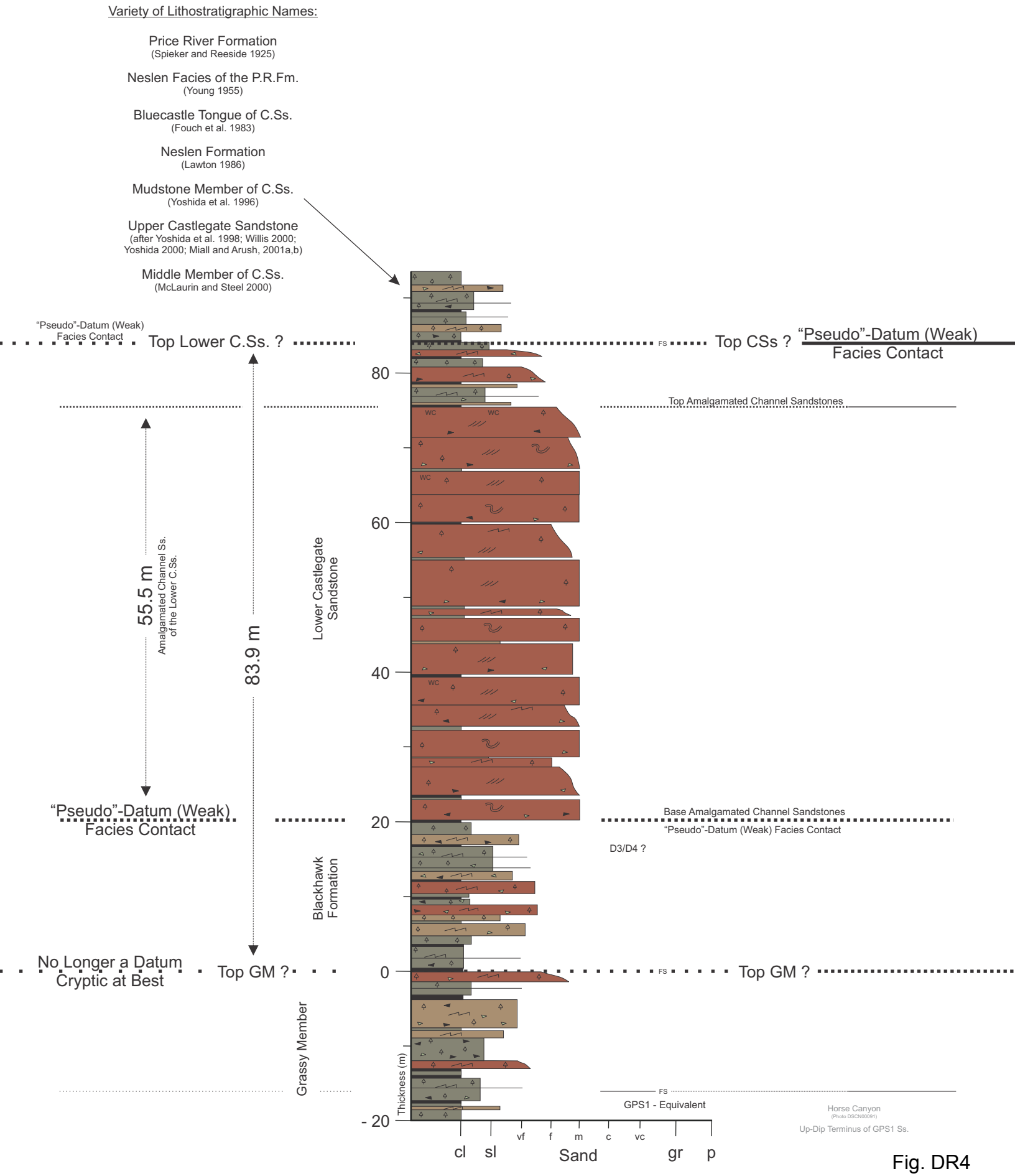


Fig. DR4

4. Woodside-Price River Canyon

Key Photos: DSCNi00961i, DSCNi00971i.

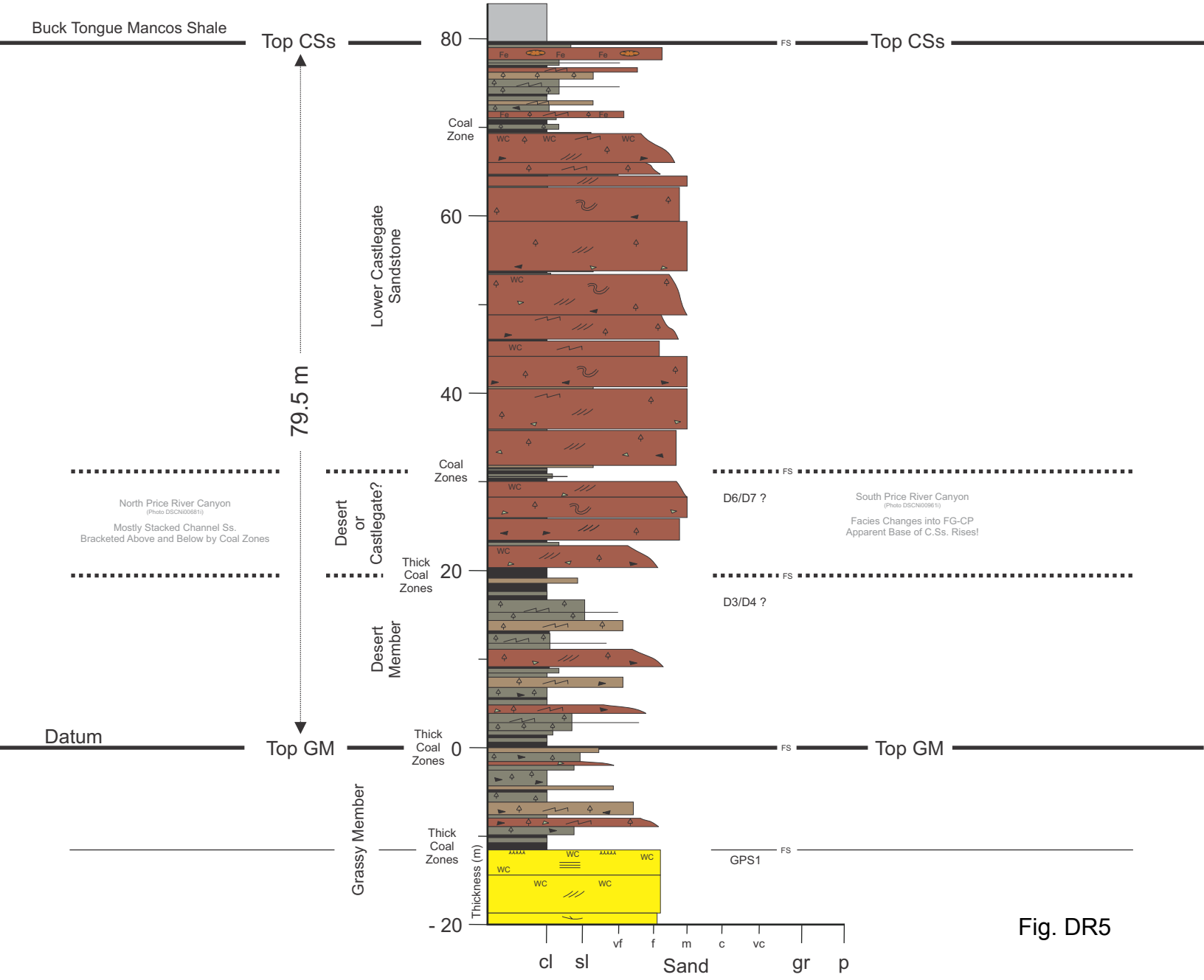


Fig. DR5

5. The Cove

Key Photos: 4374, DSCN0119, DSCN0122, 4339.

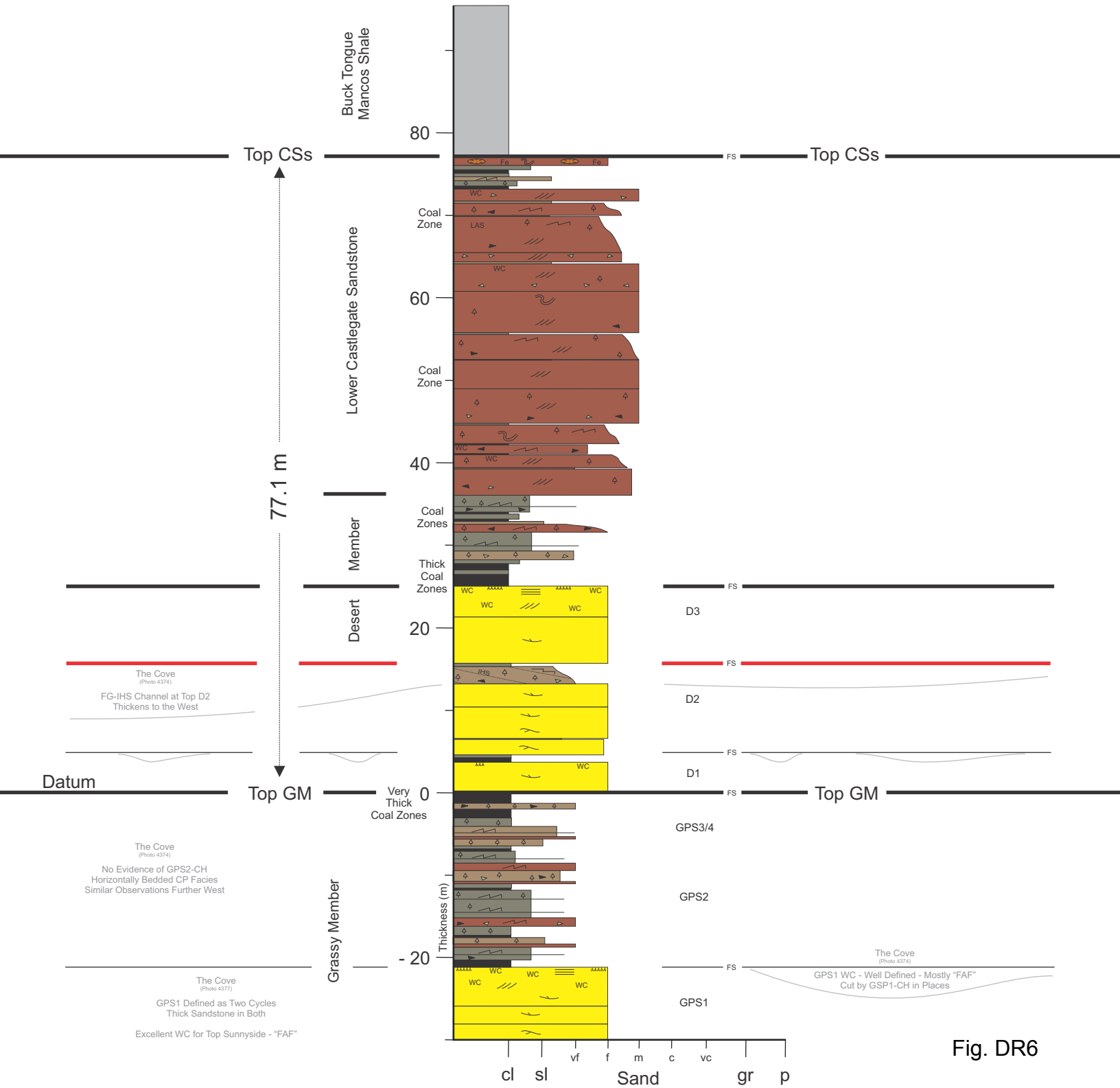


Fig. DR6

6. Middle Mountain - Central

Key Photos: DSCN0017, DSCN0016, 4352, 4375, 4377, DSCN0122.

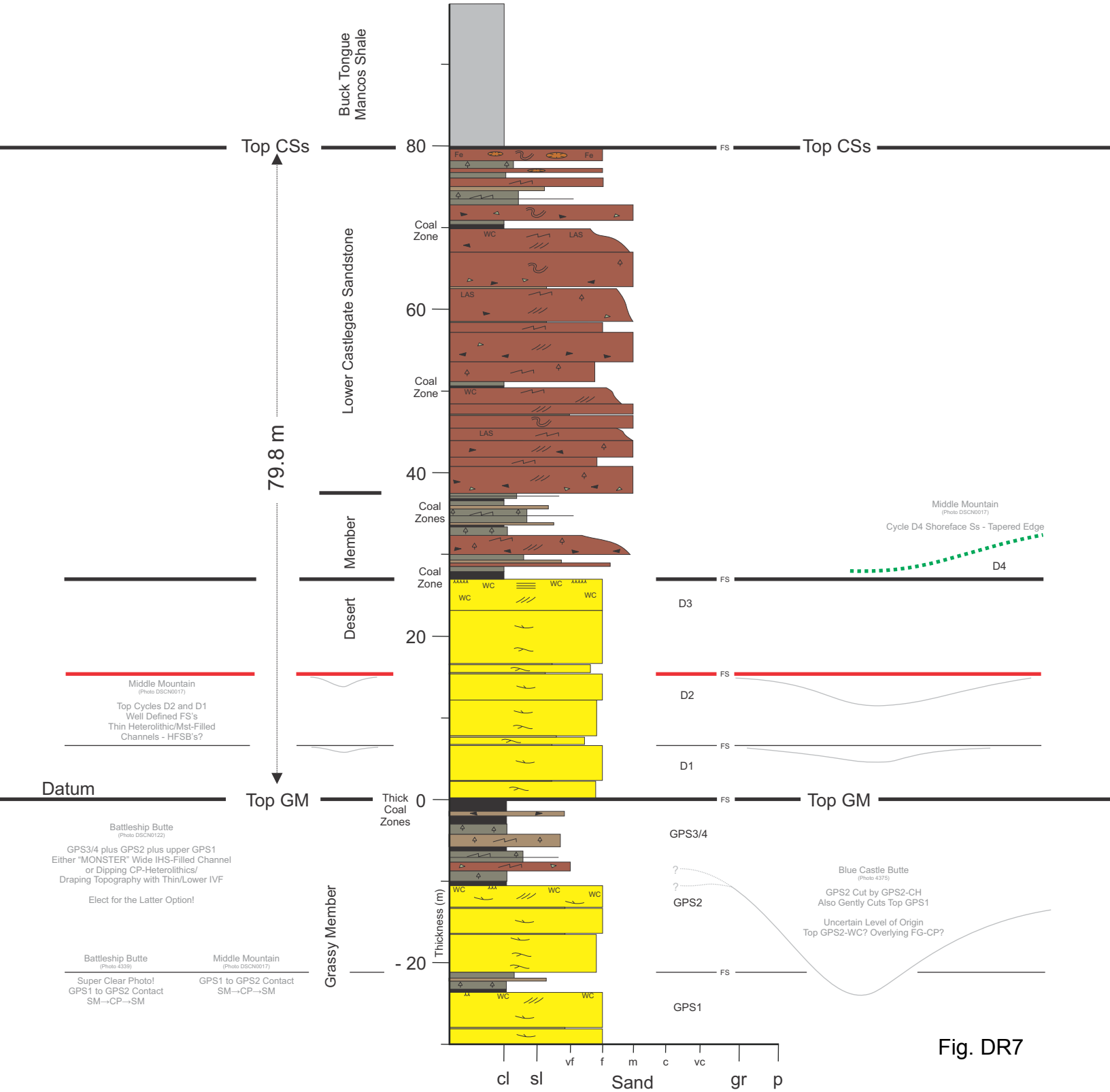


Fig. DR7

7. Middle Mountain - East

Key Photos: DSCNf0087f, DSCN0161, DSCN0158.

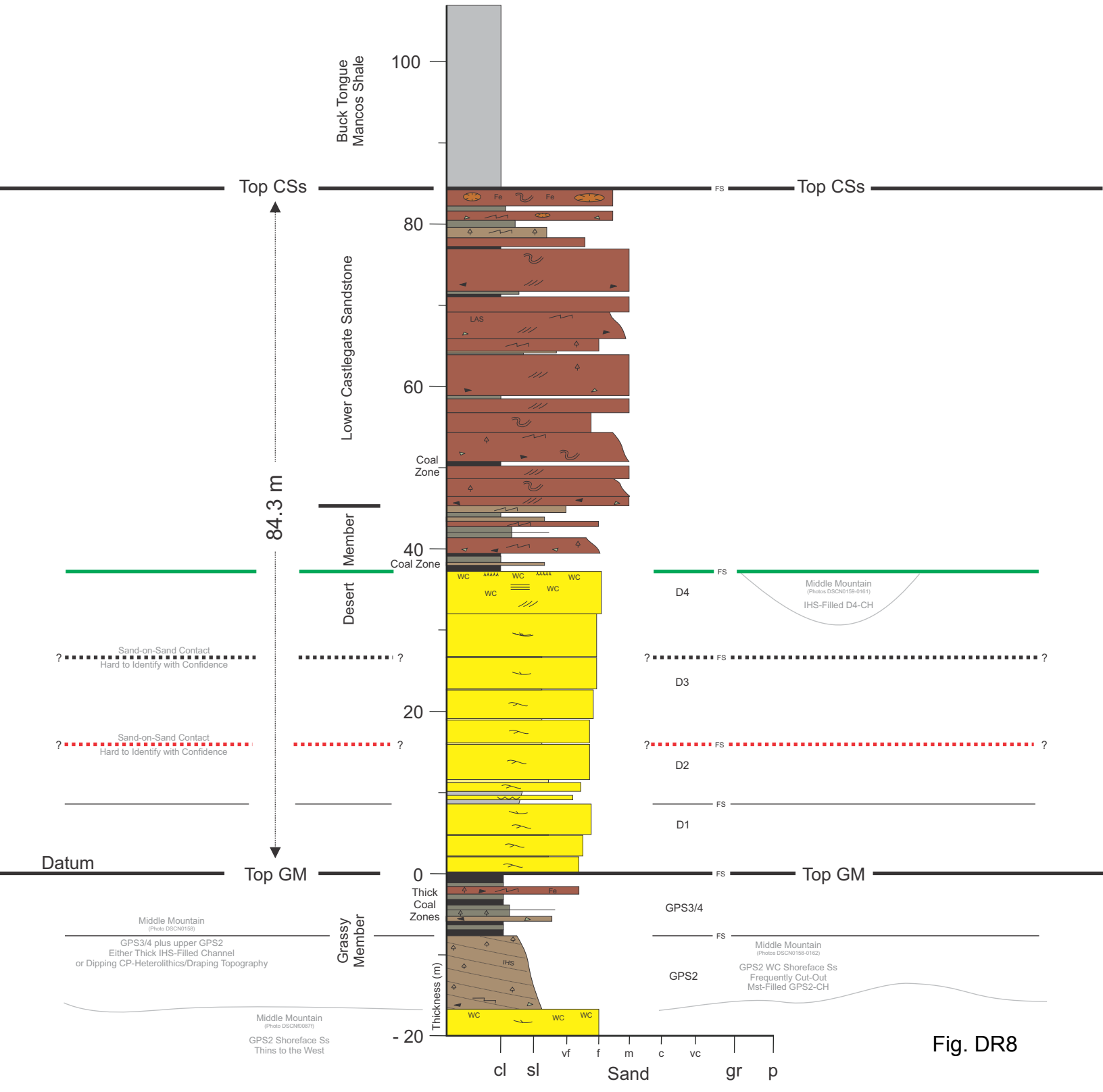


Fig. DR8

8. Long Canyon

Key Photos: DSCN01011, DSCN00761, DSCN00801, DSCN00821.

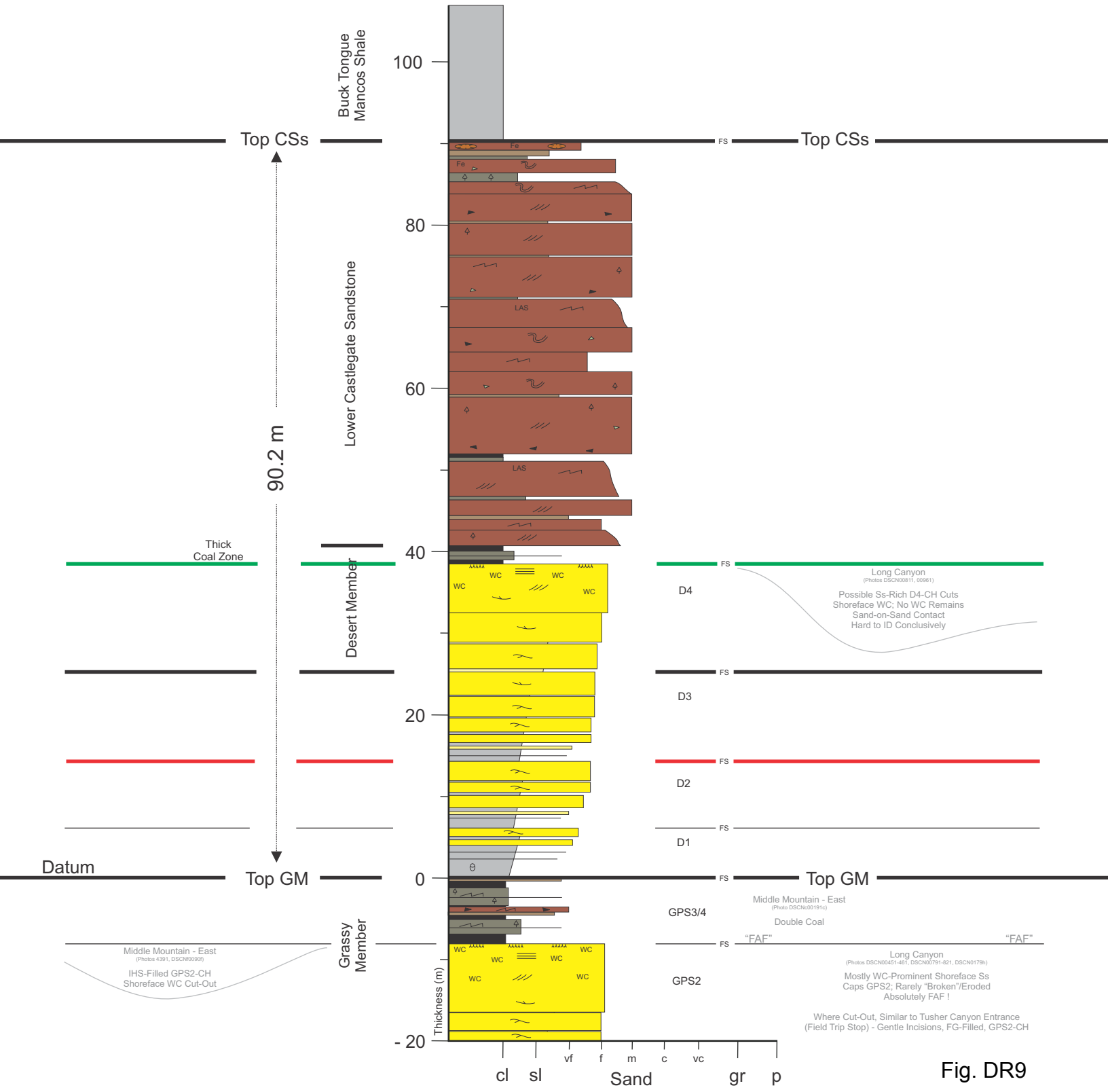


Fig. DR9

9. NE of Swaseys Beach

Key Photos: DSCNh0180h, DSCNc00351c, 4562

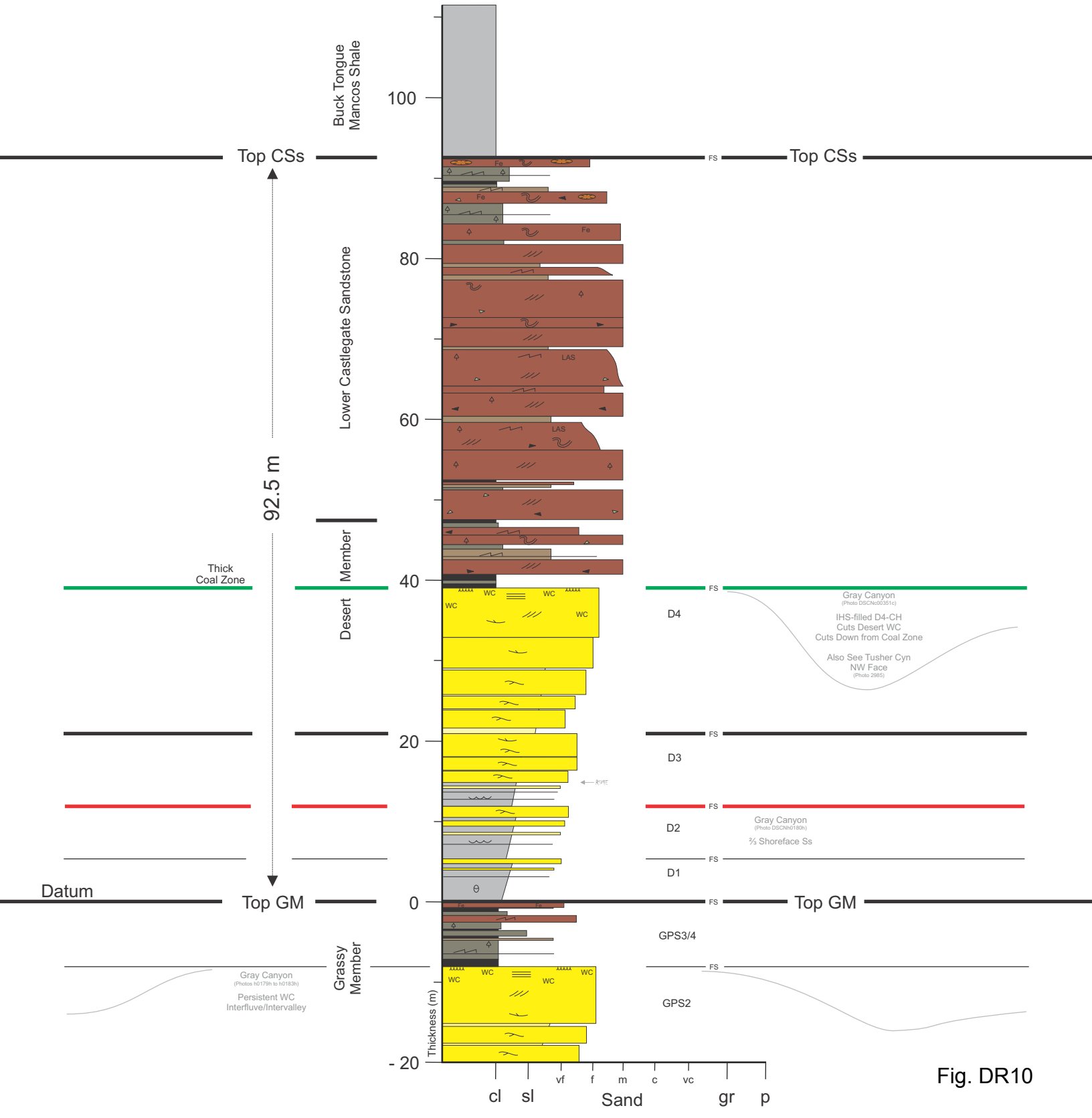


Fig. DR10

10. Tusher Canyon - N-Side Cyn-E

Key Photos: 3487, 4329/4484, 4518, 4535, 4304, 4251

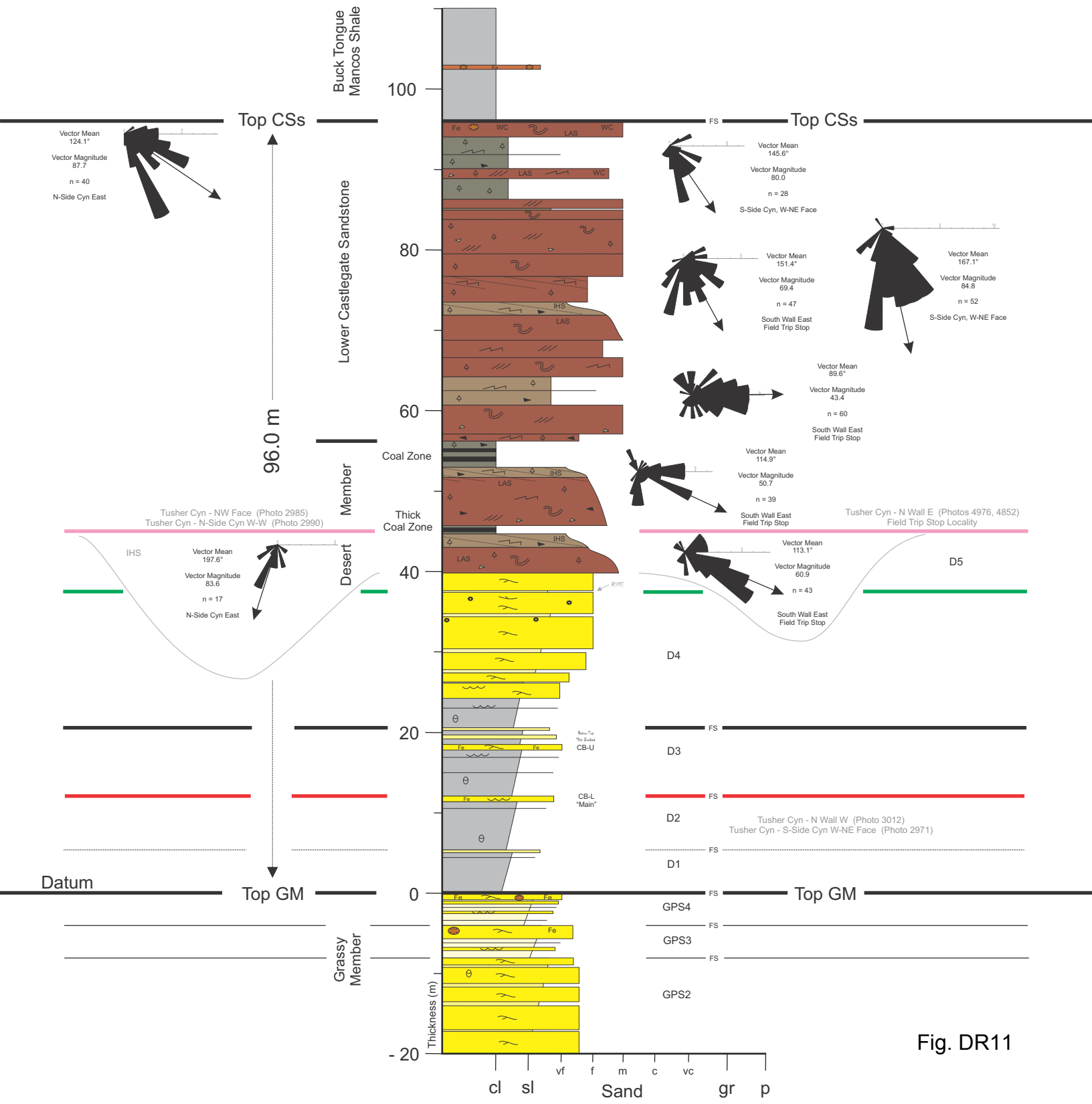


Fig. DR11

11. Coal Canyon - NW Bowl to N-Side Cyn W

Key Photos: 8679 to 2860/2866

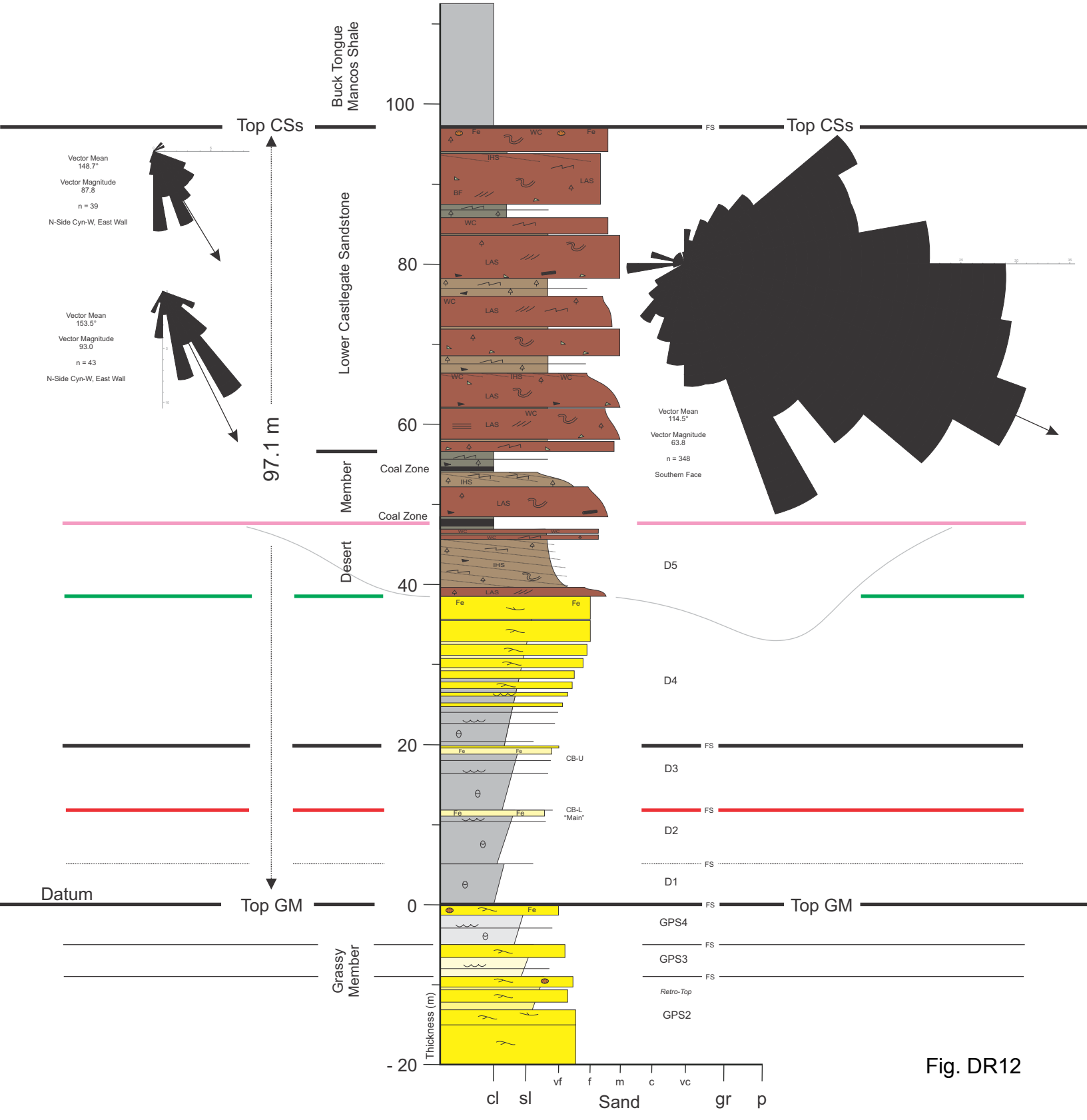


Fig. DR12

12. Coal Canyon - North Wall East

Key Photos: 2575/2597, 2550, 8326/2775, 4822/4815

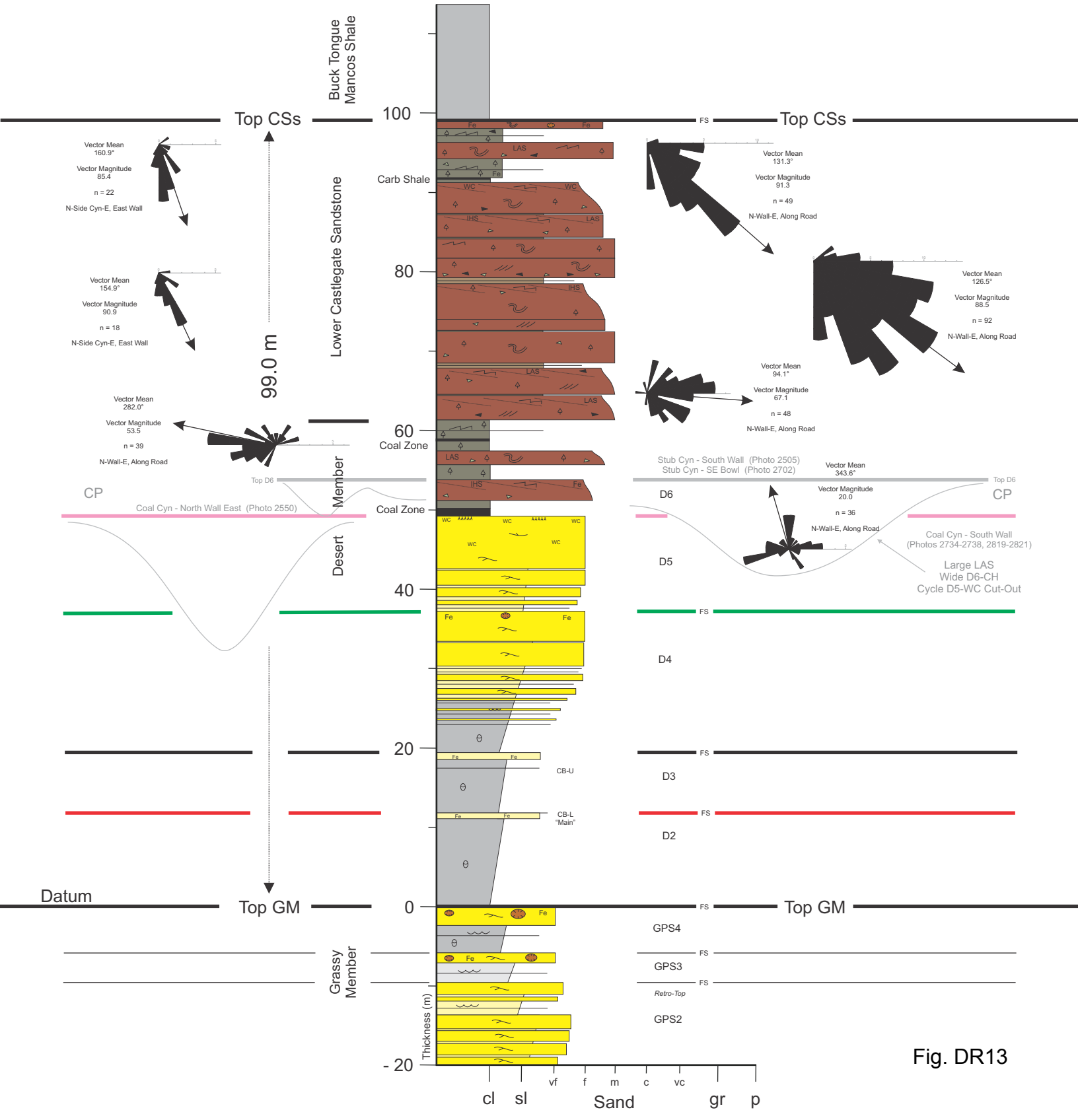


Fig. DR13

13. Stub Canyon - SE Bowl

Key Photos: 2505/2702/2279, 2282, 8253, 2253

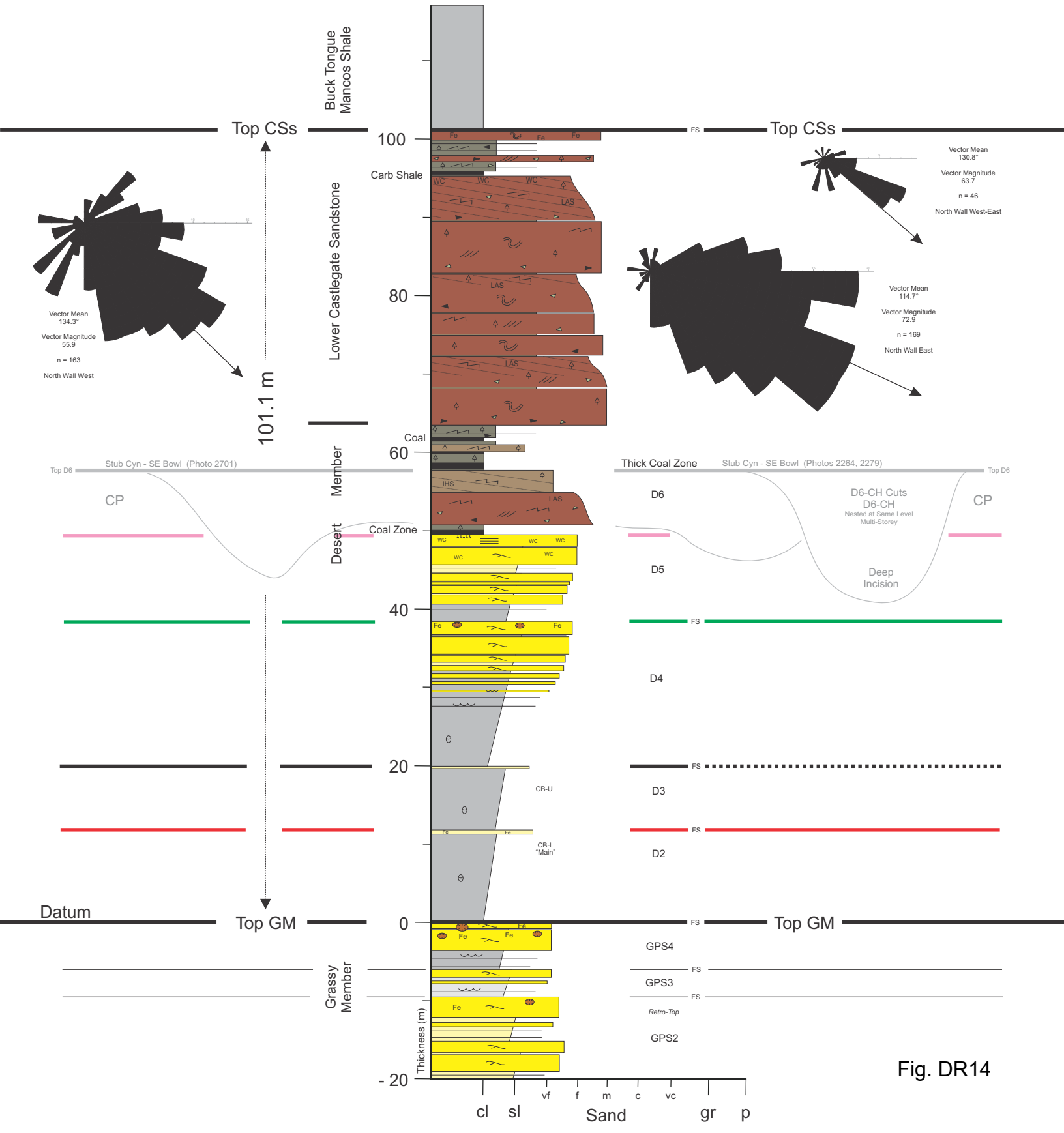


Fig. DR14

14. Browns Wash Canyon - NW Bowl

Key Photos: 2037, 2169, 2175, 2040-2041

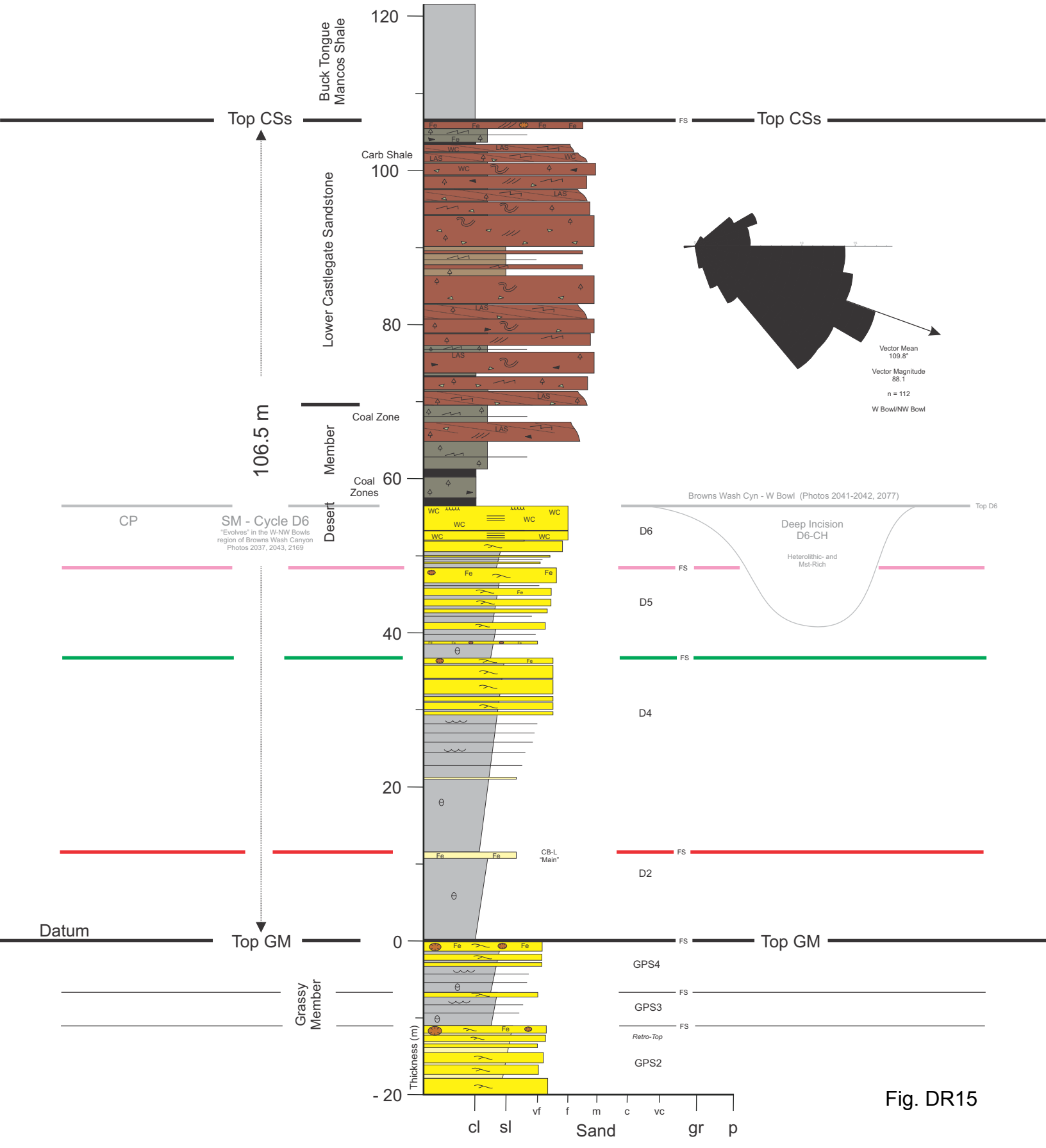


Fig. DR15

15. Browns Wash Canyon - SE Bowl

Key Photos: 2066/8104 (Css), 2069/2072 (DM), 2059/2213 (GM)

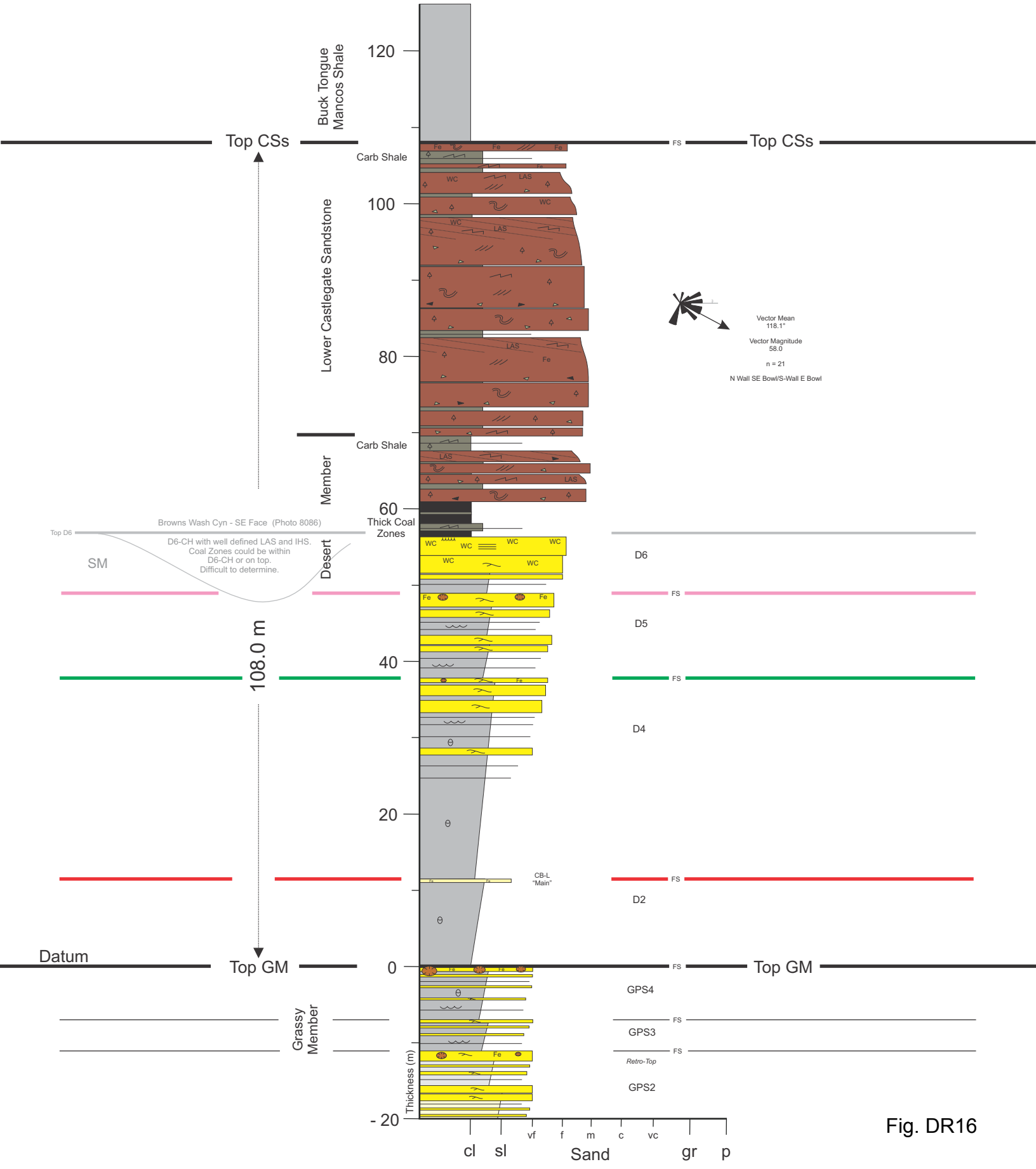


Fig. DR16

16. Horse Canyon - West Side Cyn

Key Photos: 1765/7846/8017 (CSs), 3319/8050/1869/1875 (DM), 9371/9375/9399 (GM)

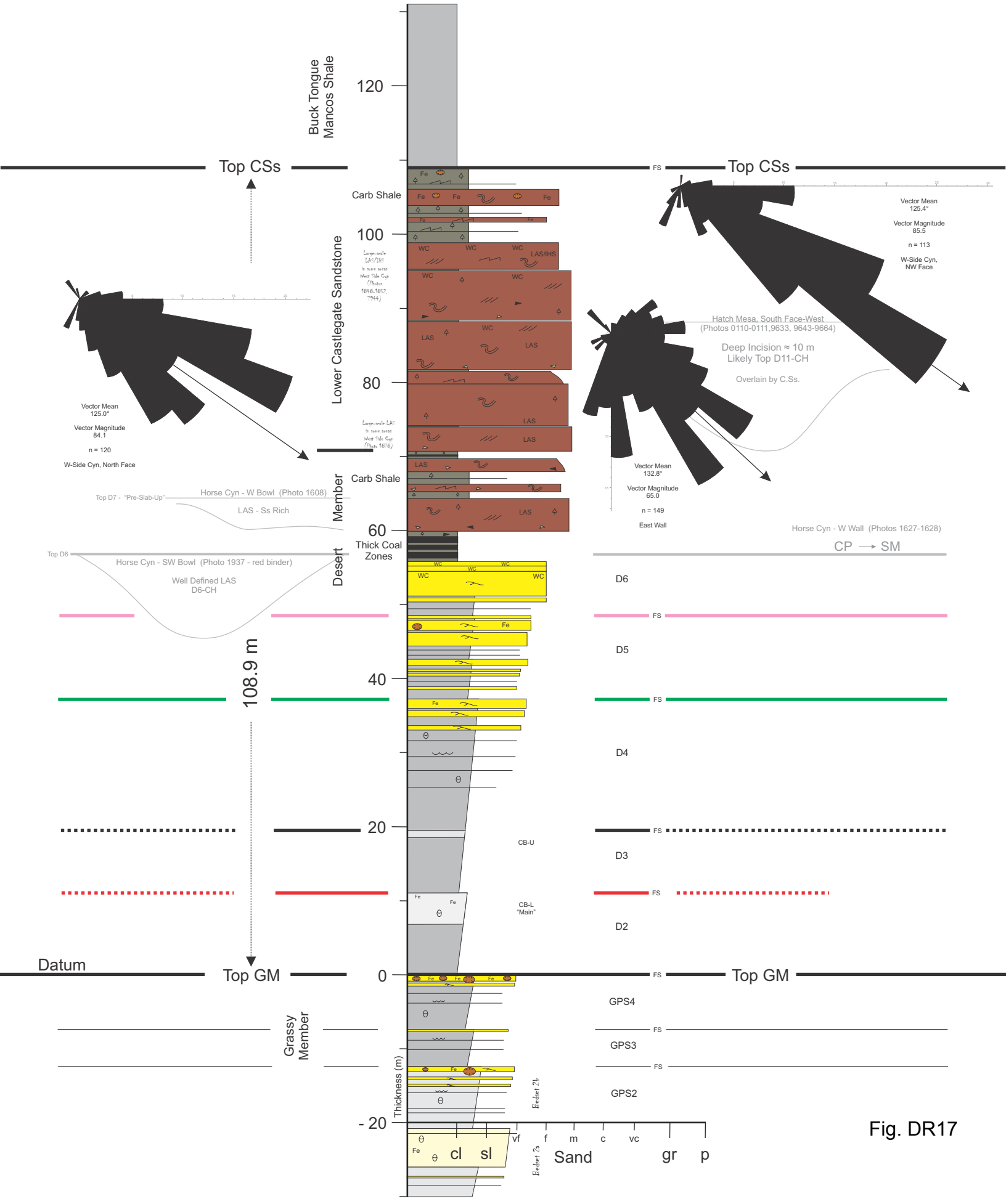
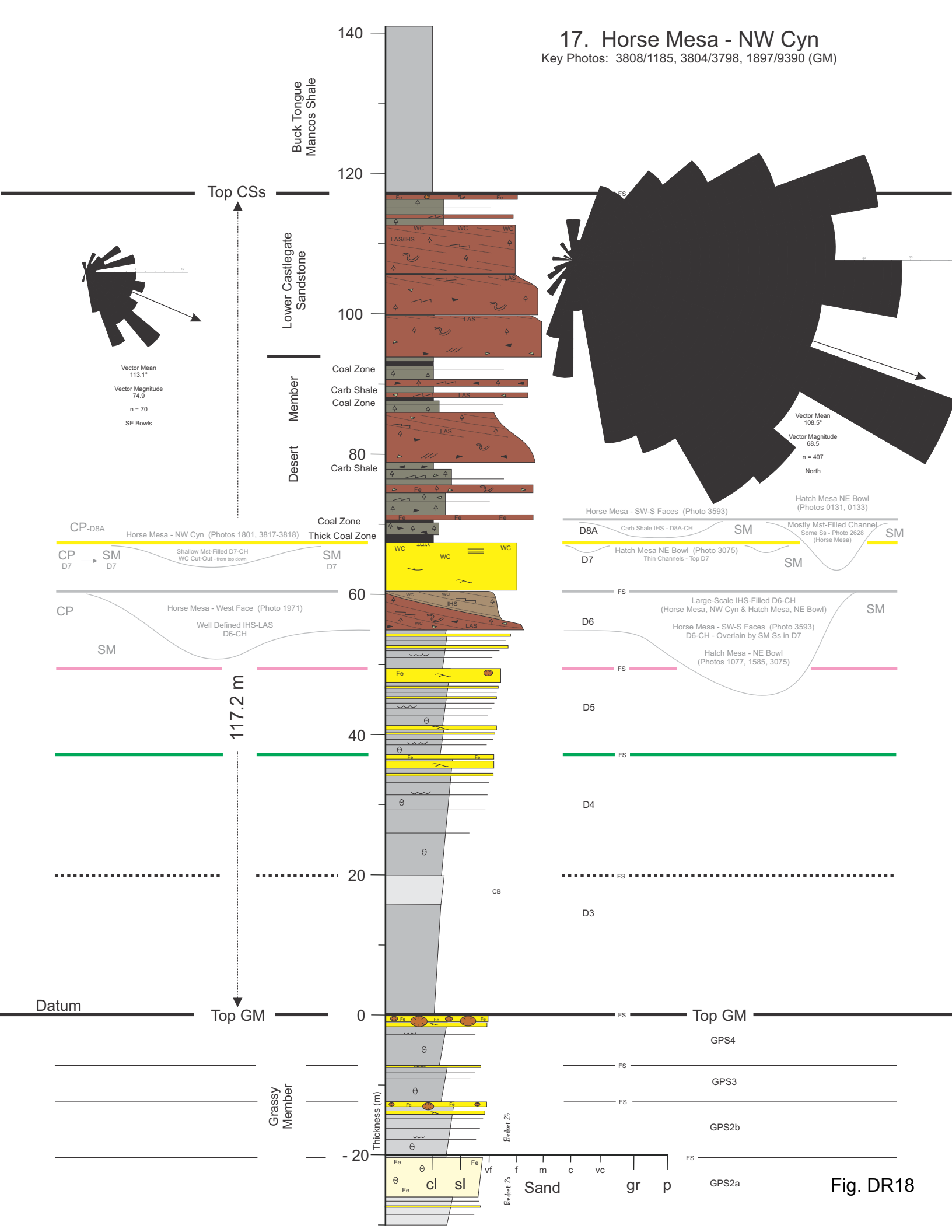


Fig. DR17

17. Horse Mesa - NW Cyn

Key Photos: 3808/1185, 3804/3798, 1897/9390 (GM)



18. Hatch Mesa - SE Bowl

Key Photos: 1077, 1082/1086, 3075/3185

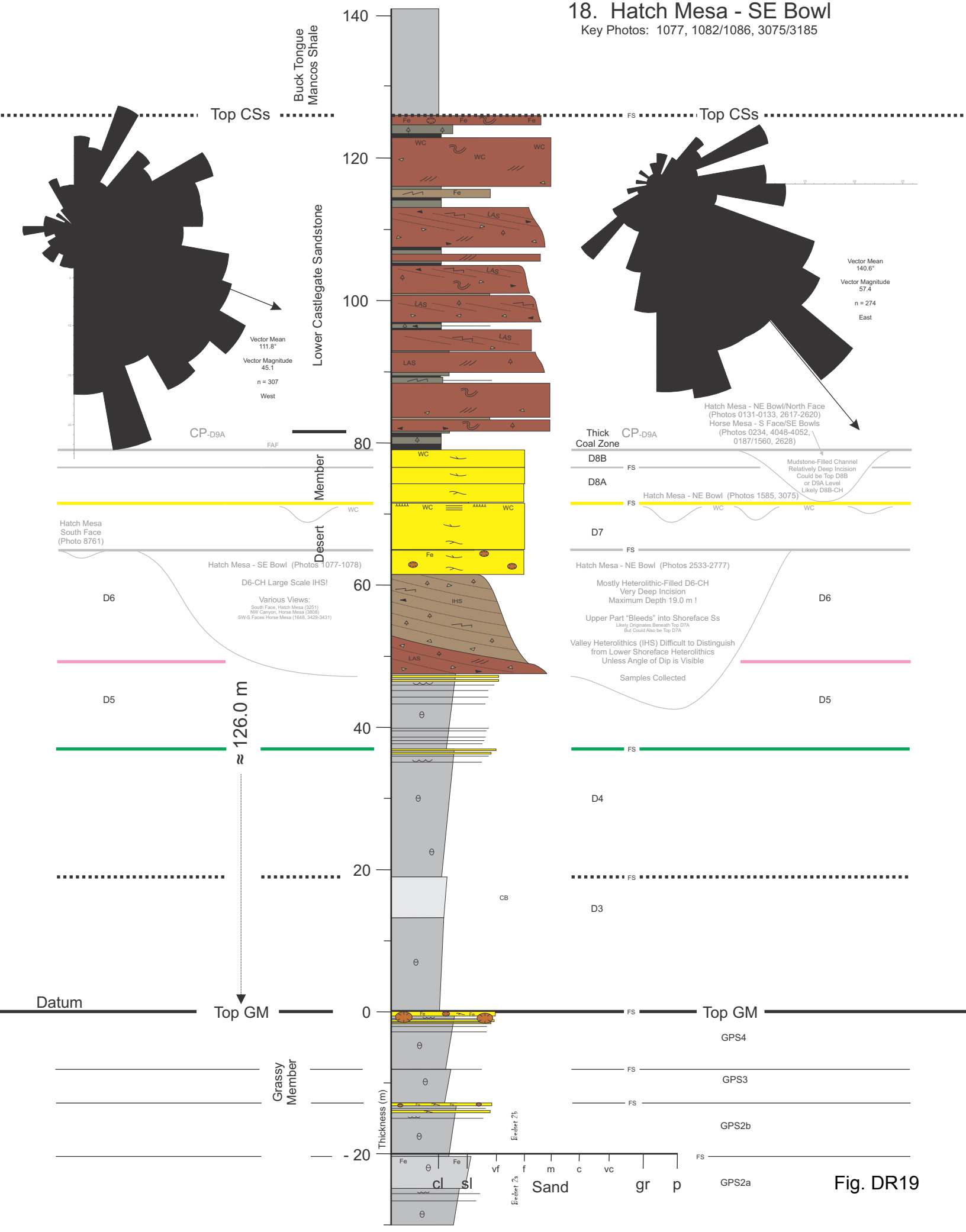


Fig. DR19

19. Trough Spring Ridge - The Basin

Key Photos: 3887/2711 (TSR), 7216/8914 (TB), 1142 (East Cyn, TB)

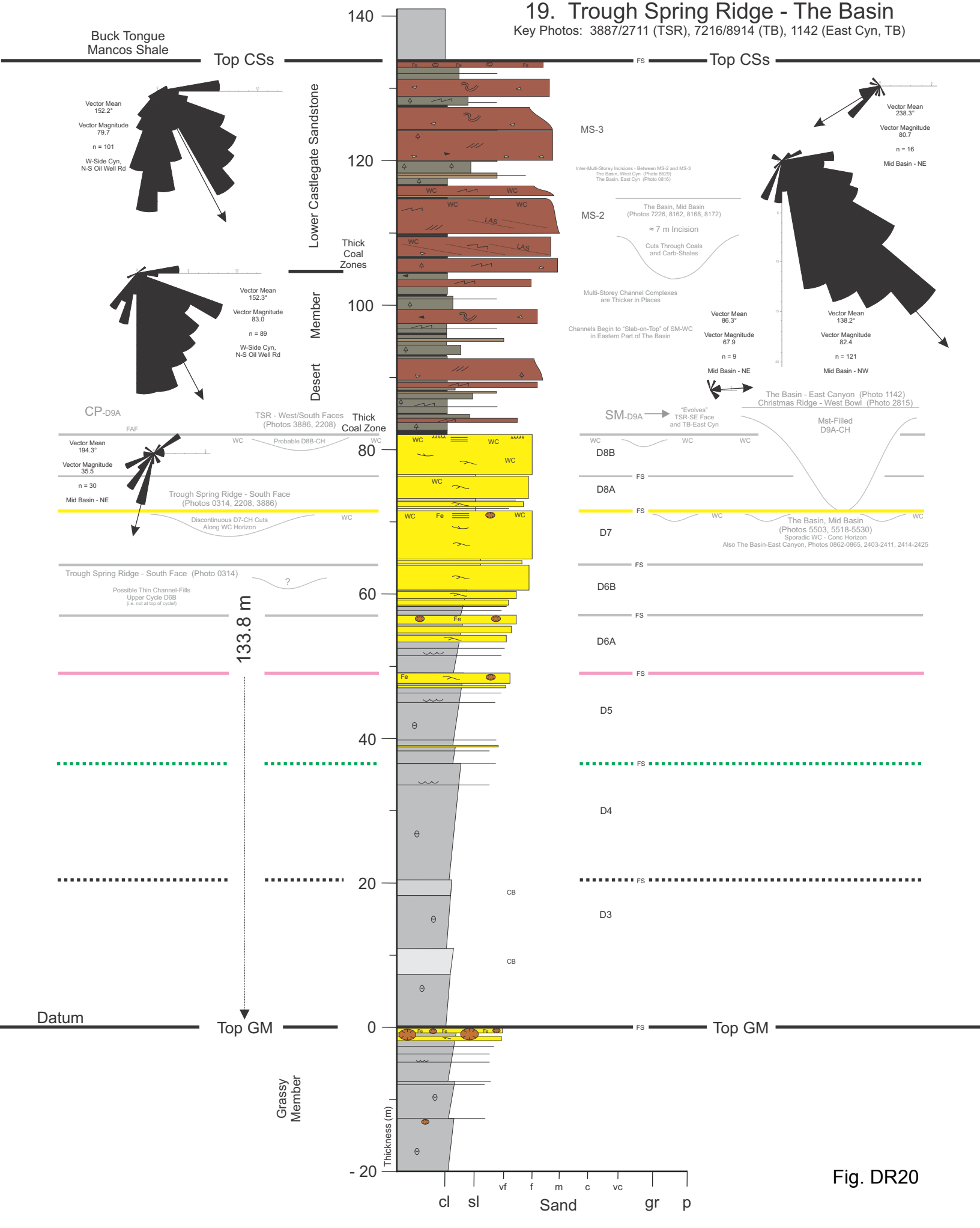


Fig. DR20

Buck Tongue - Mancos Shale

20. Trough Spring Ridge - East Face

Key Photos: 2761/1469-1470/1466 (East Face), 2717 (South Face)

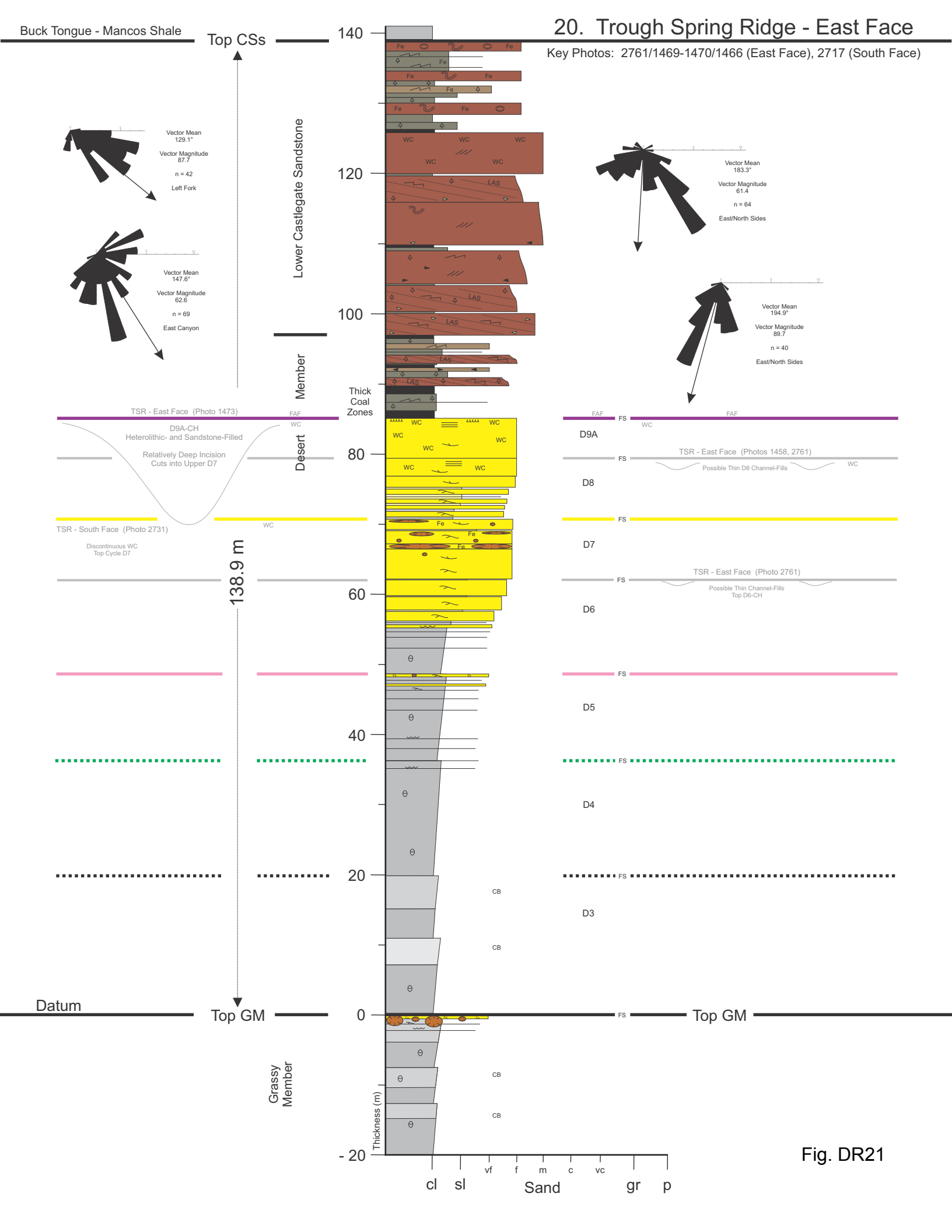
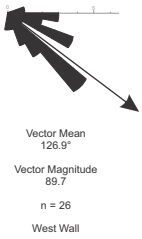
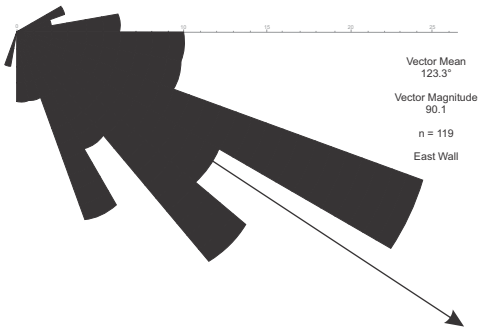


Fig. DR21

21. Floy Wash - East Wall

Key Photos: 0753, 1937, 7427, 0530-0531 (ThP-SWFace)





Buck Tongue - Mancos Shale

Top CSs

Lower Castlegate Sandstone

Floy Wash - West Wall (Photos 0416, 0723-0729, 1802, 1956)

Mainly Broad-Shallow Incisions - None on East Wall
Heterolithic- and Mudstone-Filled D9A-CH
Deepest Cut Through All WC Ss's
Mostly Upper D9A Only

Desert Member

Thick Coal Zones

D8A - Thick SM Sandstone
see Photos 0748-0753
Clinoform. Top D8A drops and loses sandstone.

136.6 m

Datum

Top GM

Grassy Member

Thickness (m)

140
120
100
80
60
40
20
0
- 20

FAF
FS
WC
CB
LAS
Fe
θ

D9A
D8
D7
D6
D5
D4
D3

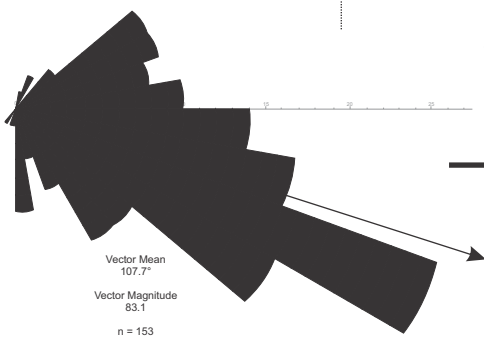
Prominent CB
Top Bedset 2a
Below

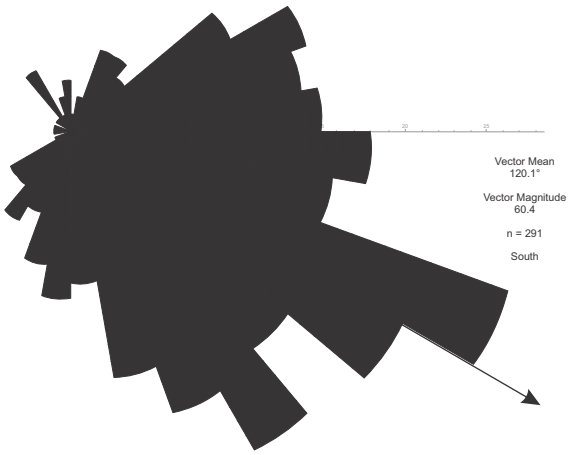
cl sl vf f m c vc gr p
Sand

Fig. DR22

22. Christmas Ridge - SE Bowl

Key Photos: 0080, 0029, 0054, 1241, 1243, 8399
0318/0335/3057/4097 (CP)





Buck Tongue - Mancos Shale

Top CSs

Lower Castlegate Sandstone

Desert Member

Grassy Member

Datum

Top GM

Thick Coal Zones

Christmas Ridge - SW Face
(Photos 0346, 1918, 3240, 4103, 2727)
West Bowl (Photo 1446), NW Bowl (Photo 1835)

D9A-CH Incision
Cuts D9 and into D8

Mostly Mudstone-Filled
Some Thin Ss Beds

D9B ? possibly evolves
NW Bowl
(Photos 2844-2848)

136.8 m

Prominent CB
Top Bedset 2a
Below

Thickness (m)

Sand

cl sl vf f m c vc gr p

D9A D8 D7 D6 D5 D4 D3

FAF FS WC Fe CB LAS

Fig. DR23

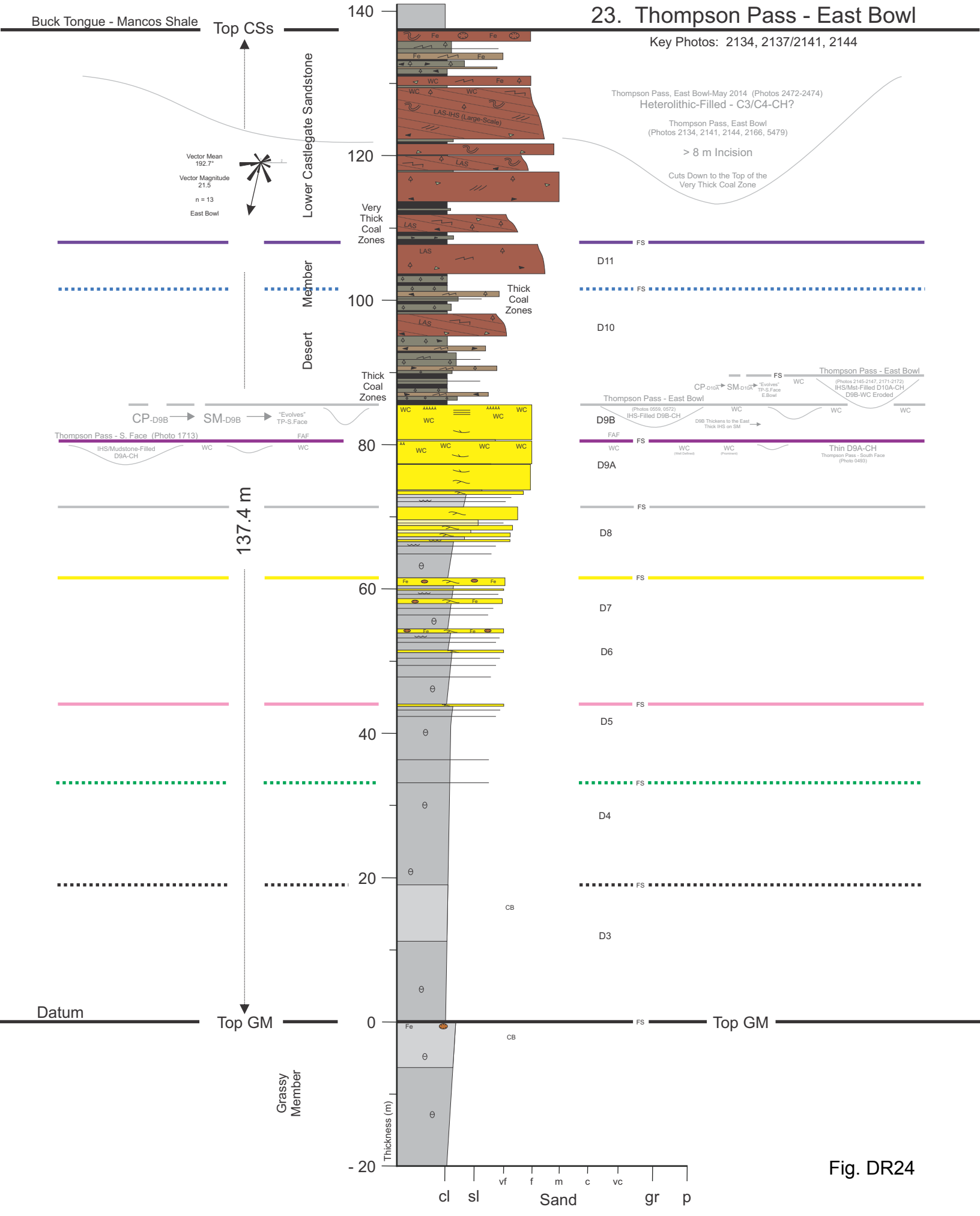

23. Thompson Pass - East Bowl
Key Photos: 2134, 2137/2141, 2144
Buck Tongue - Mancos Shale
Top CSs
Lower Castlegate Sandstone
Desert Member
Grassy Member
Datum
Top GM
Vector Mean 192.7°
Vector Magnitude 21.5
n = 13
East Bowl
Thompson Pass, East Bowl-May 2014 (Photos 2472-2474)
Heterolithic-Filled - C3/C4-CH?
Thompson Pass, East Bowl
(Photos 2134, 2141, 2144, 2166, 5479)
> 8 m Incision
Cuts Down to the Top of the Very Thick Coal Zone
Very Thick Coal Zones
Thick Coal Zones
Thick Coal Zones
LAS-IHS (Large-Scale)
LAS
CP-D9B
SM-D9B
"Evolves" TP-S.Face
Thompson Pass - S. Face (Photo 1713)
IHS/Mudstone-Filled D9A-CH
137.4 m
CB
Thickness (m)
140
120
100
80
60
40
20
0
- 20
cl
sl
vf
f
m
c
vc
Sand
gr
p
D11
D10
D9B
D9A
D8
D7
D6
D5
D4
D3
FS
WC
FAF
Thompson Pass - East Bowl
CP-D10A
SM-D10A
IHS/Mst-Filled D10A-CH
D9B-WC Eroded
IHS-Filled D9B-CH
Thin D9A-CH

Fig. DR24

24. Crescent Cyn - SW Wall/W-Side Cyn

Key Photos: 6961/6999, 2353/4983 (W Side Cyn), 0037/0038 (Husky May 2012)

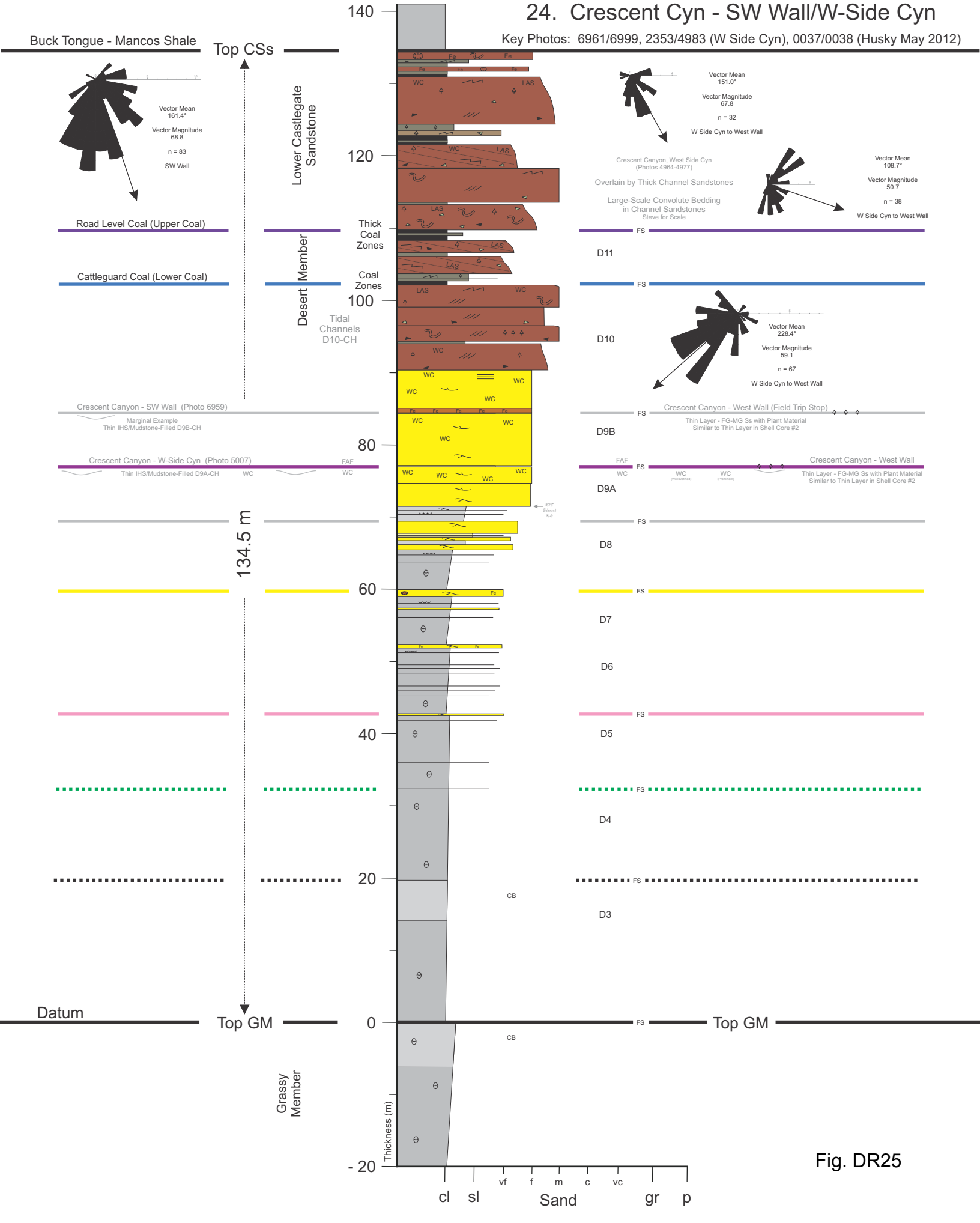


Fig. DR25

25. Horse Heaven - NW/SW Bowls

Key Photos: 5125, 5149, 5151, 5157 (NW Bowl)
1723, 5279, 5353, 5109, 5276, 7009 (SW Bowl)

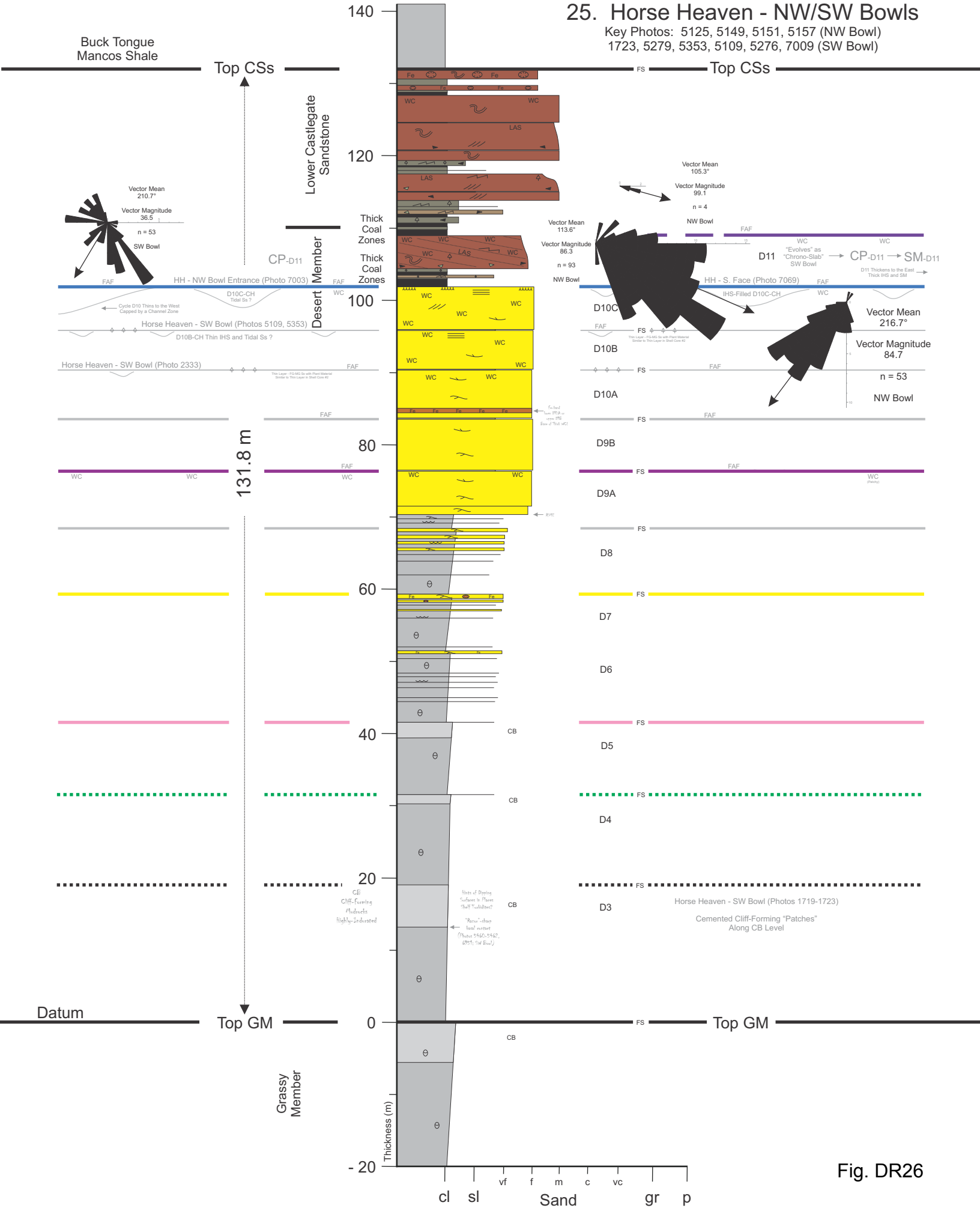


Fig. DR26

26. Horse Heaven - South Face East

Key Photos: 7053, 5136, 1738, 1742, 5517, 1766

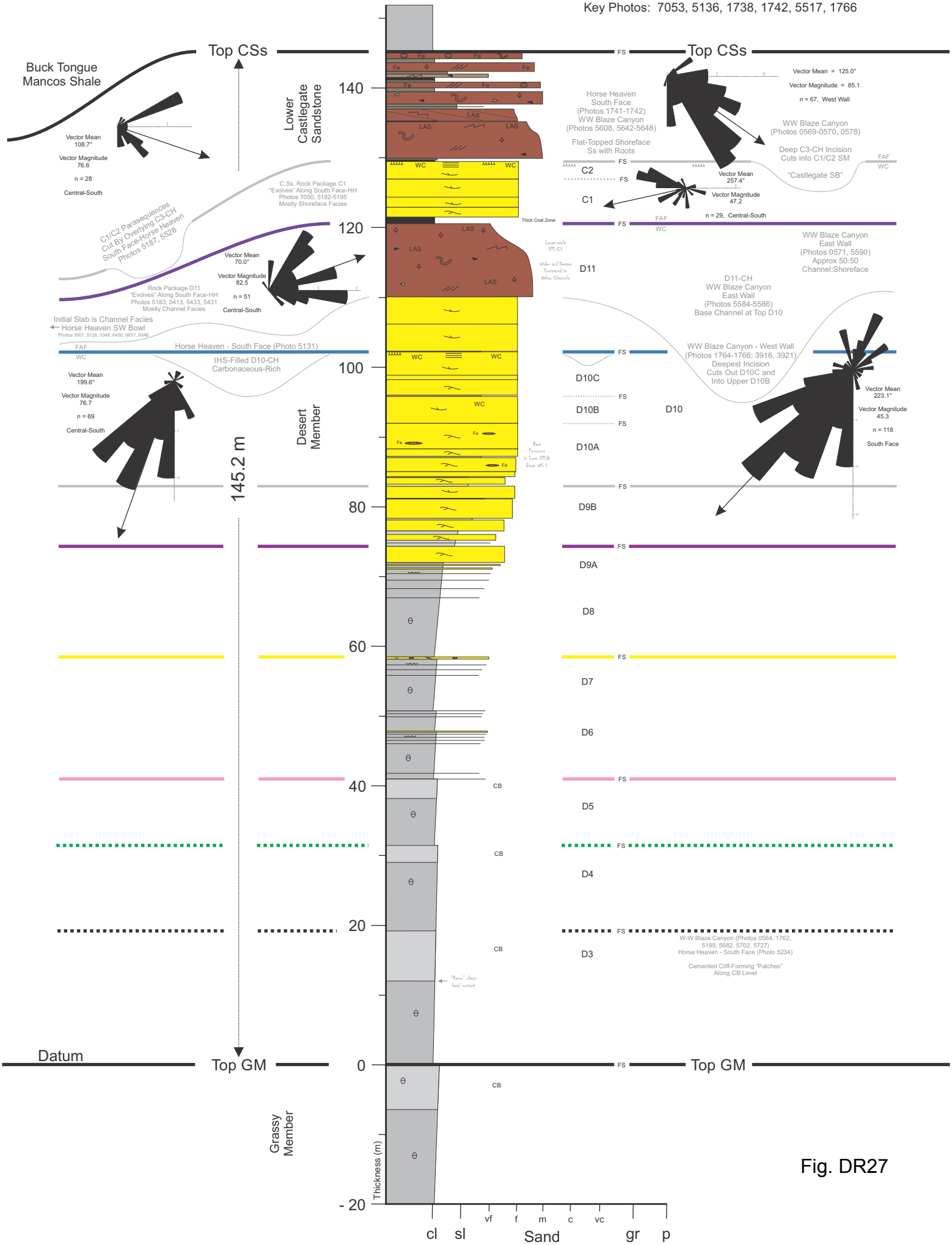


Fig. DR27

27. West of Blaze Canyon - East Wall

Key Photos: 5865, 5773, 6235-6236; 1802/1804 (West Wall)

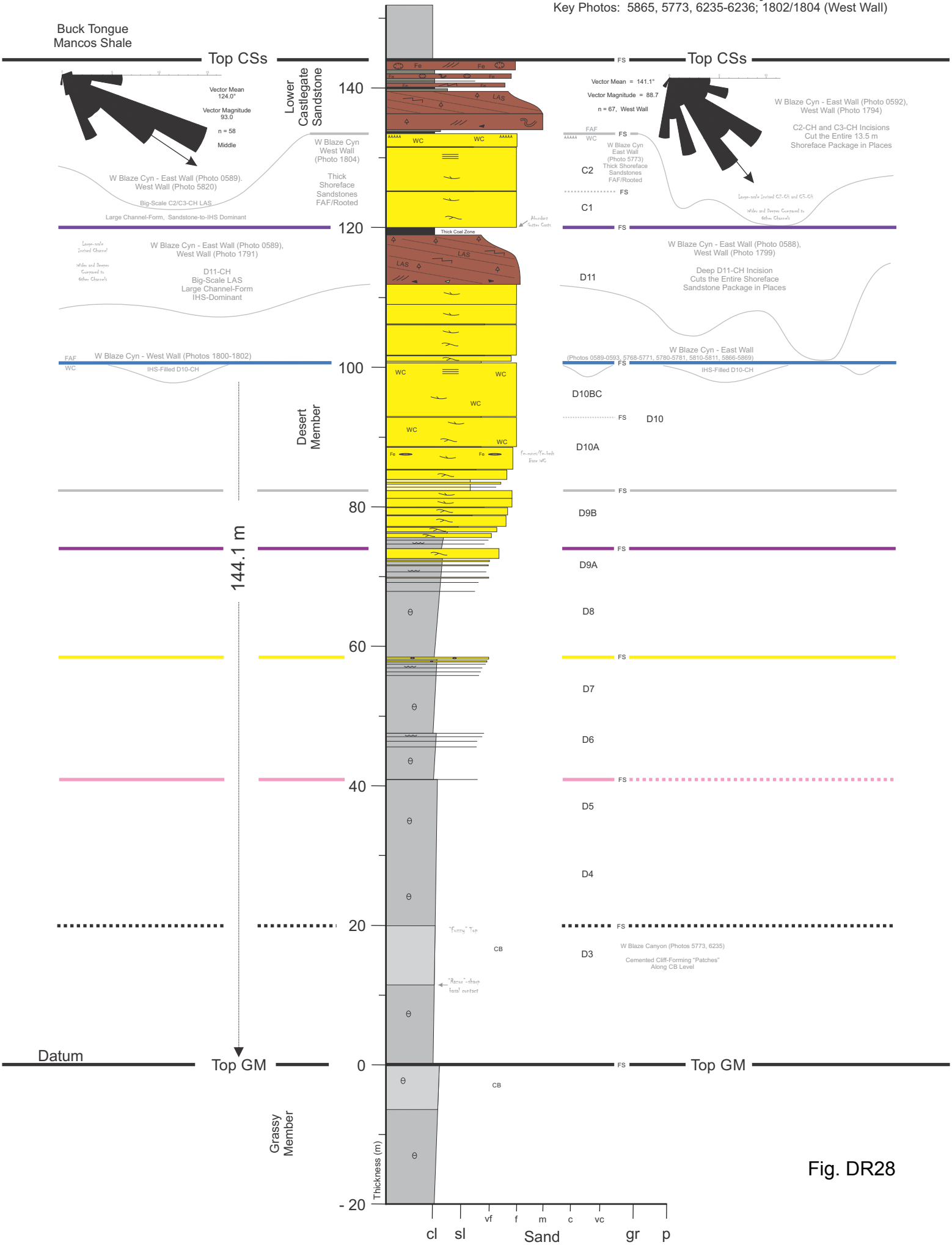


Fig. DR28

28. Blaze Canyon - East Side Cyn

Key Photos: 1872/1874, 7123, 5888, 5890, 5921, 5986

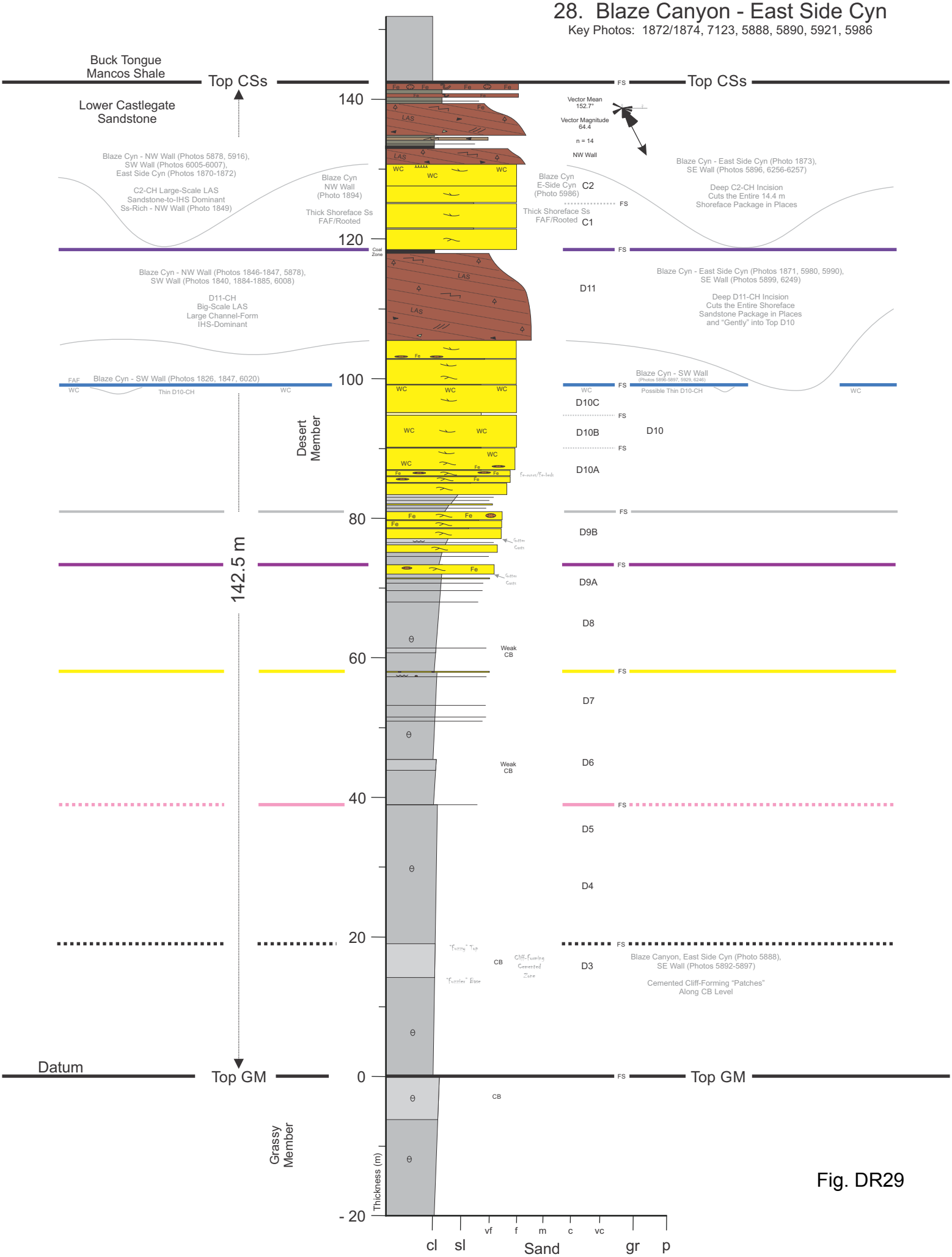


Fig. DR29

29. Thompson Canyon - West Side Cyn

Key Photos: 8798/8803, 8808/8812, 8816/1900/1901, 1928/1923, 1929/1935

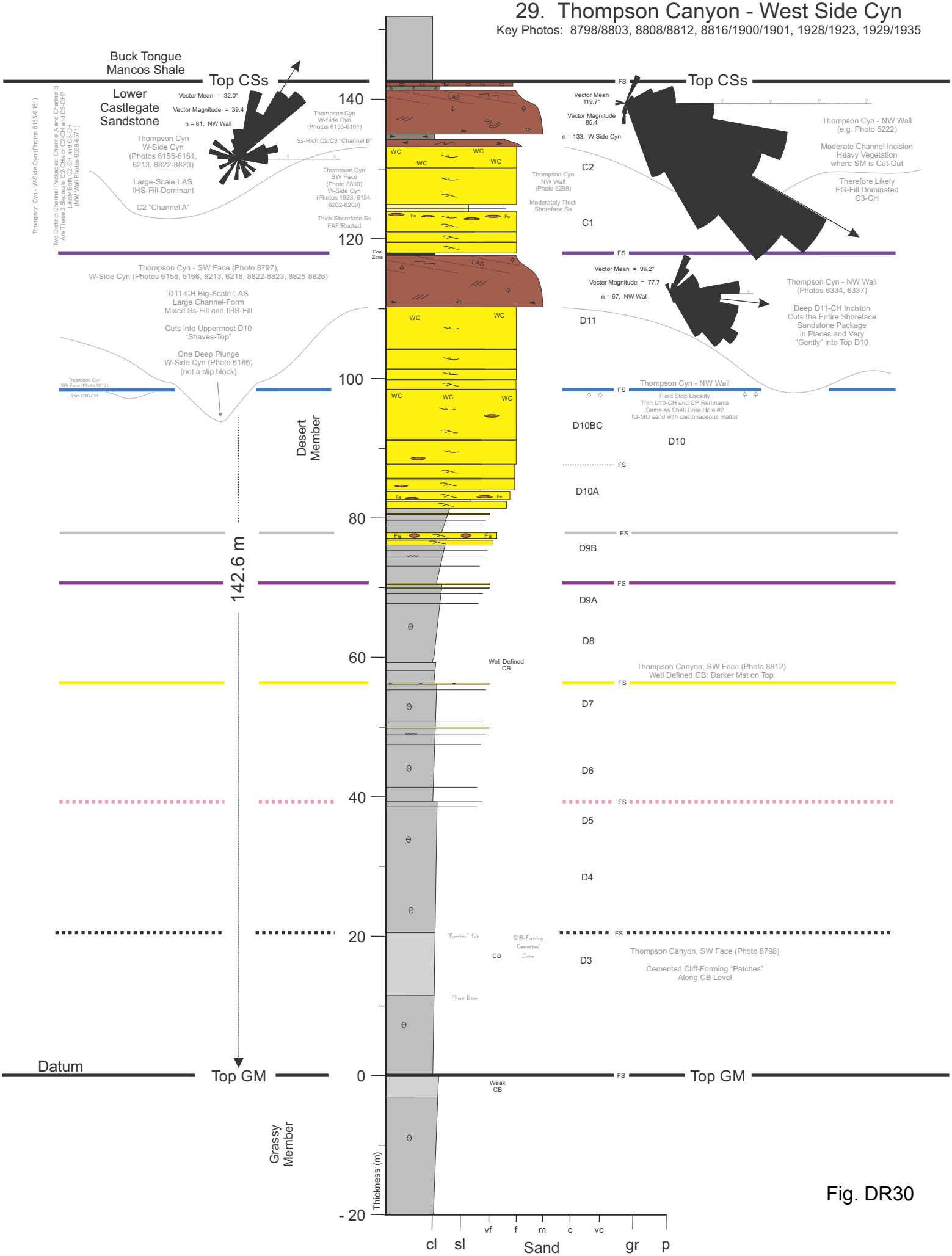


Fig. DR30

30. Thompson Canyon - East Side Cyn

Key Photos: 6484/6516/6118 (SE Face), 6380

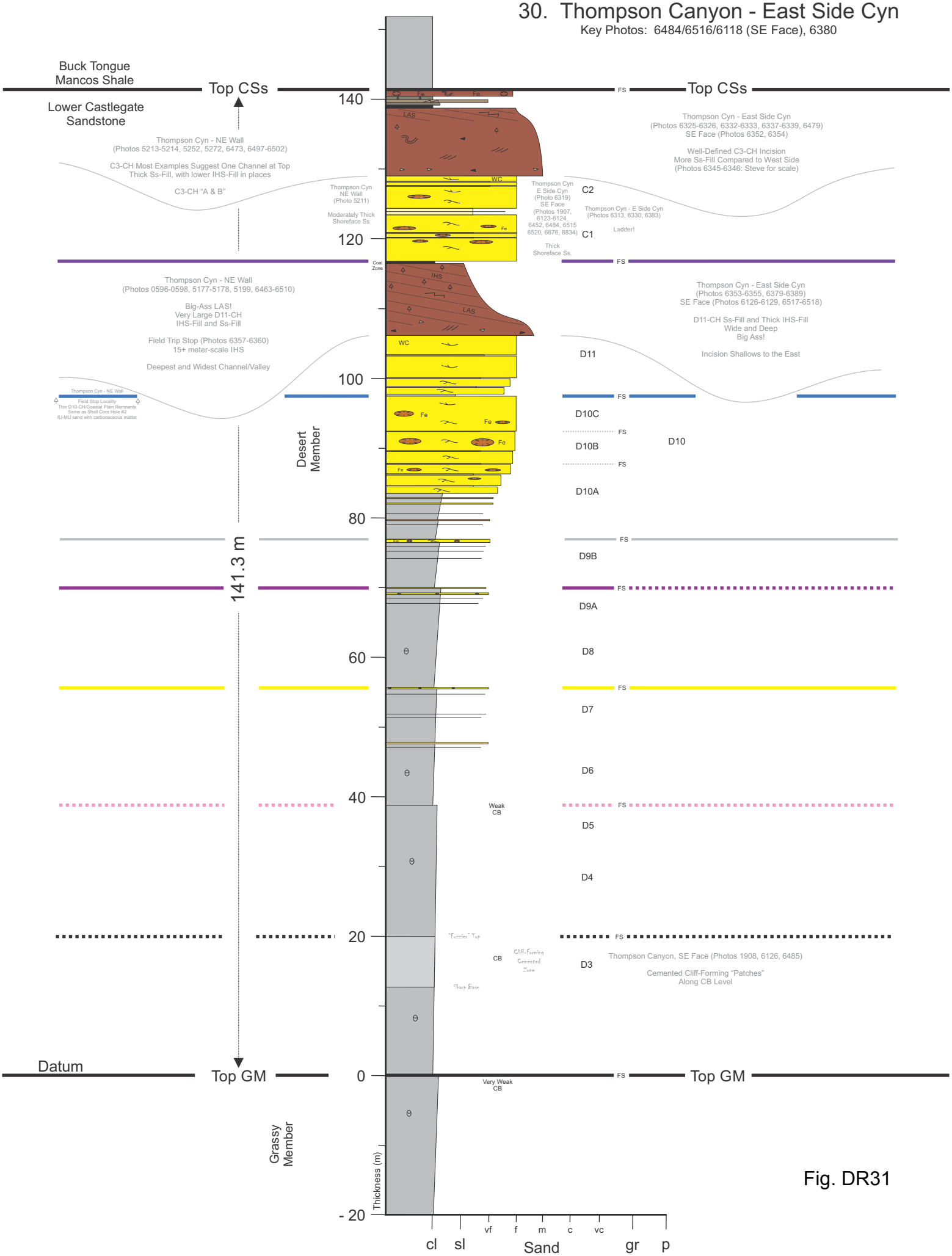


Fig. DR31

31. Salt Wash Canyon - NE Side Cyn

Key Photos: 0052, 9257, 0051/0103-01044/8860/8918 (SE Face)

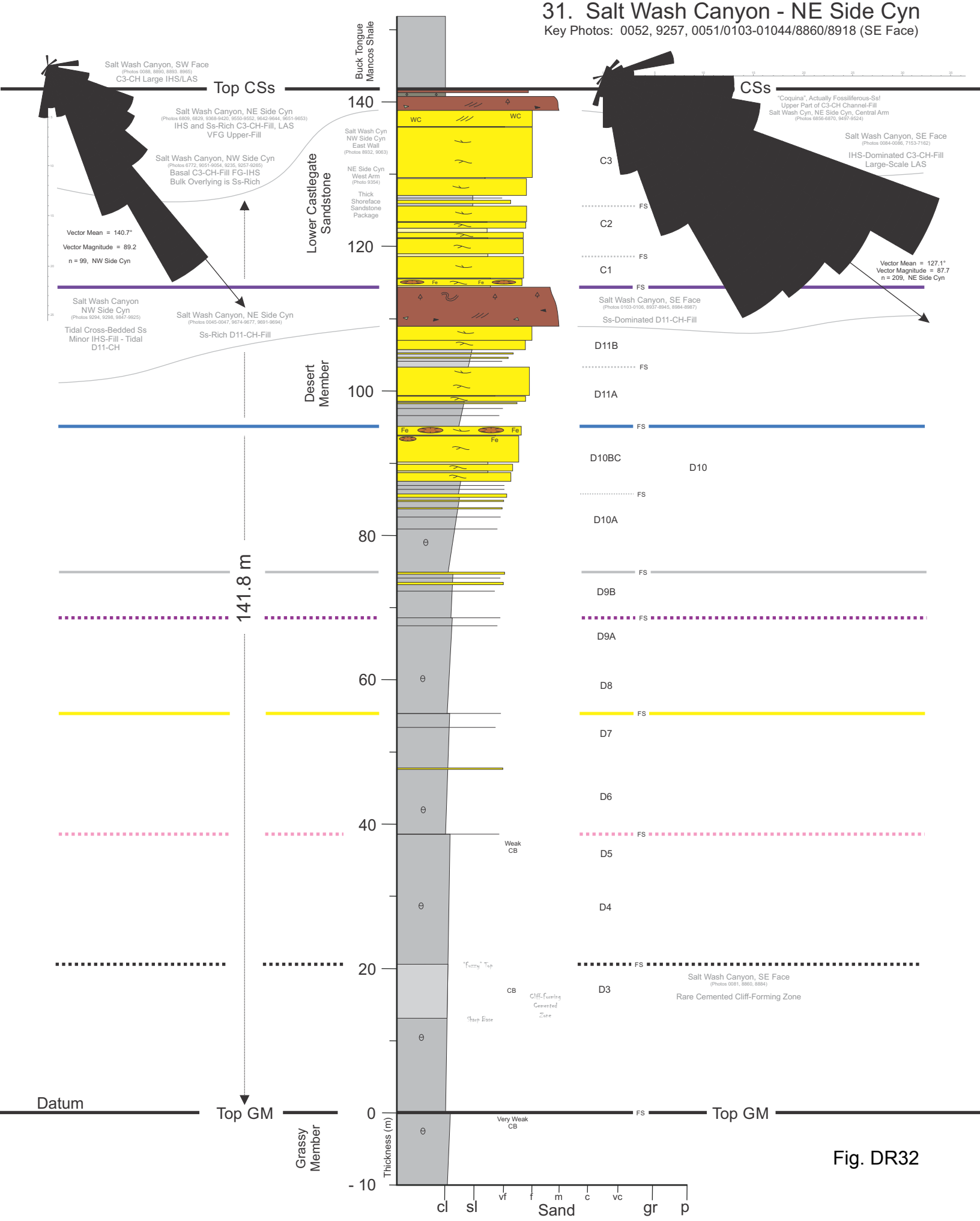


Fig. DR32

32. Bootlegger Wash Canyons - West Cyn

Key Photos: 0237, 0259, 0228 7276; 0496, 0219, 0213 (West Bowl)

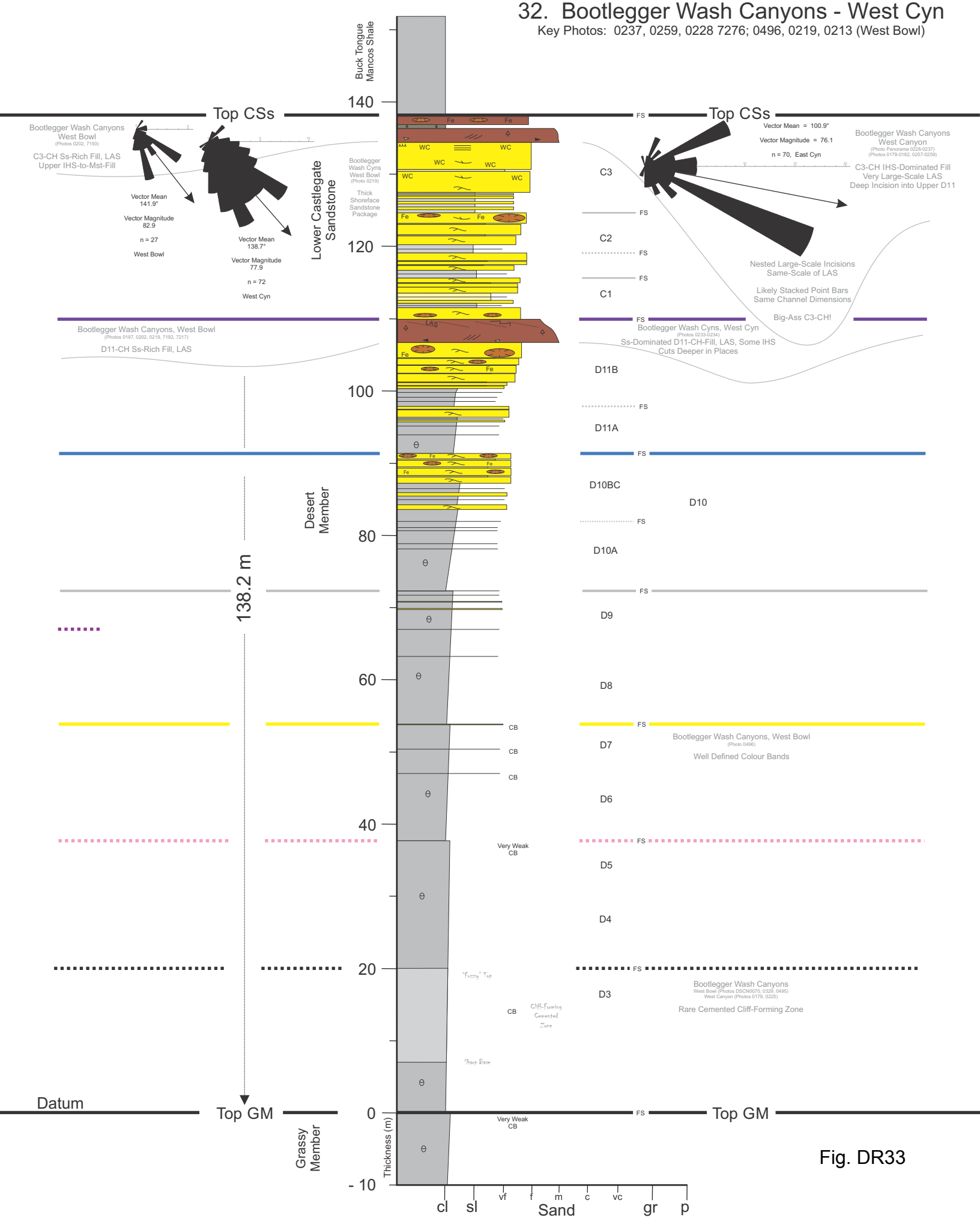


Fig. DR33

33. Sagers Canyon - NW Wall

Key Photos: 0828, 0831 (SW Wall); 0605, 7400 (West Bowl);
0740 (NW Wall); 0717, 0804 (North Wall);
0755 (NE Wall/Bowl); 0575 (SE Wall)

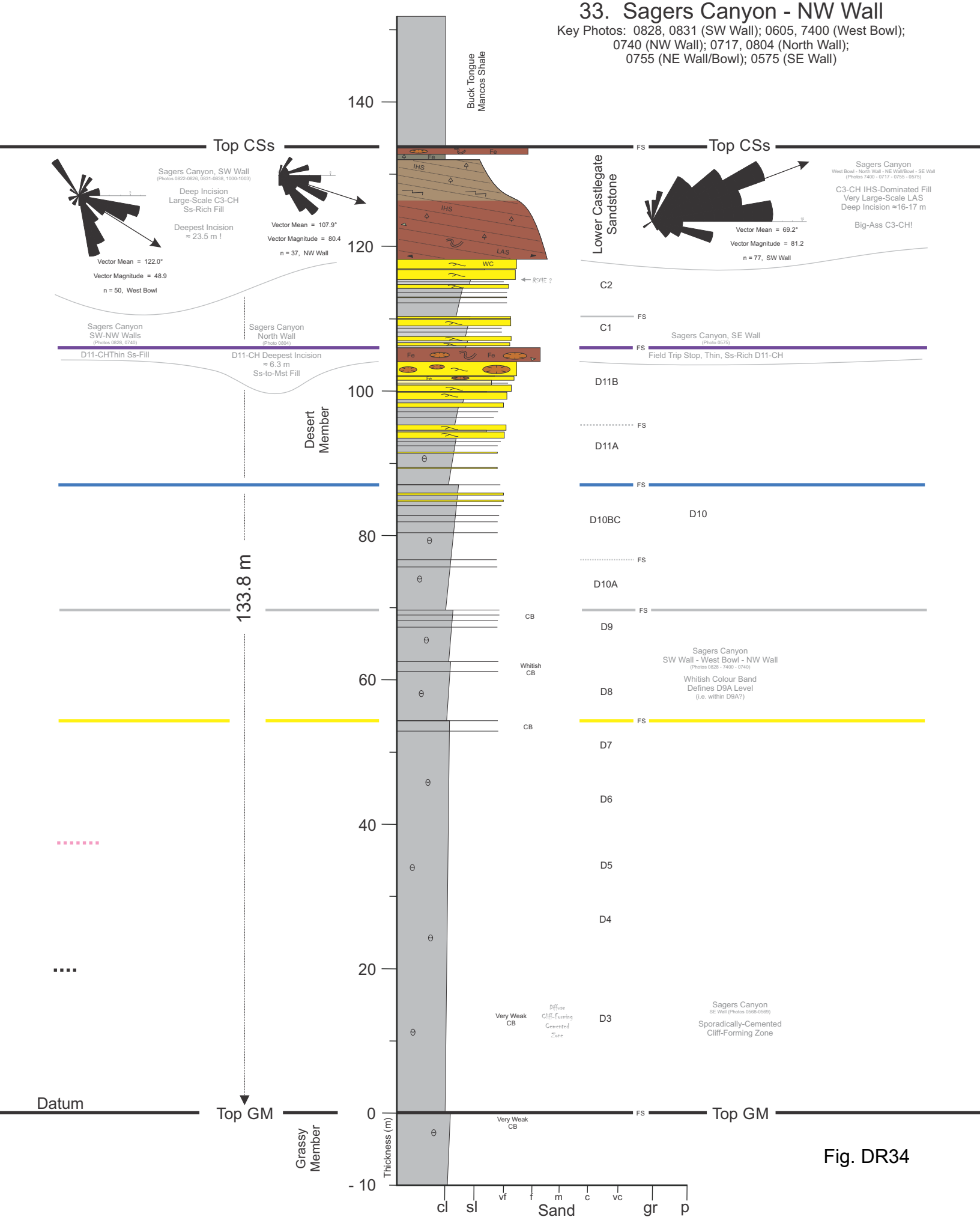


Fig. DR34

34. East of Sagers Canyon - East Wall

Key Photos: 7483, 0974, 0852, 0876,
0878-0879, 0930, 0932; 0985 (West Wall)

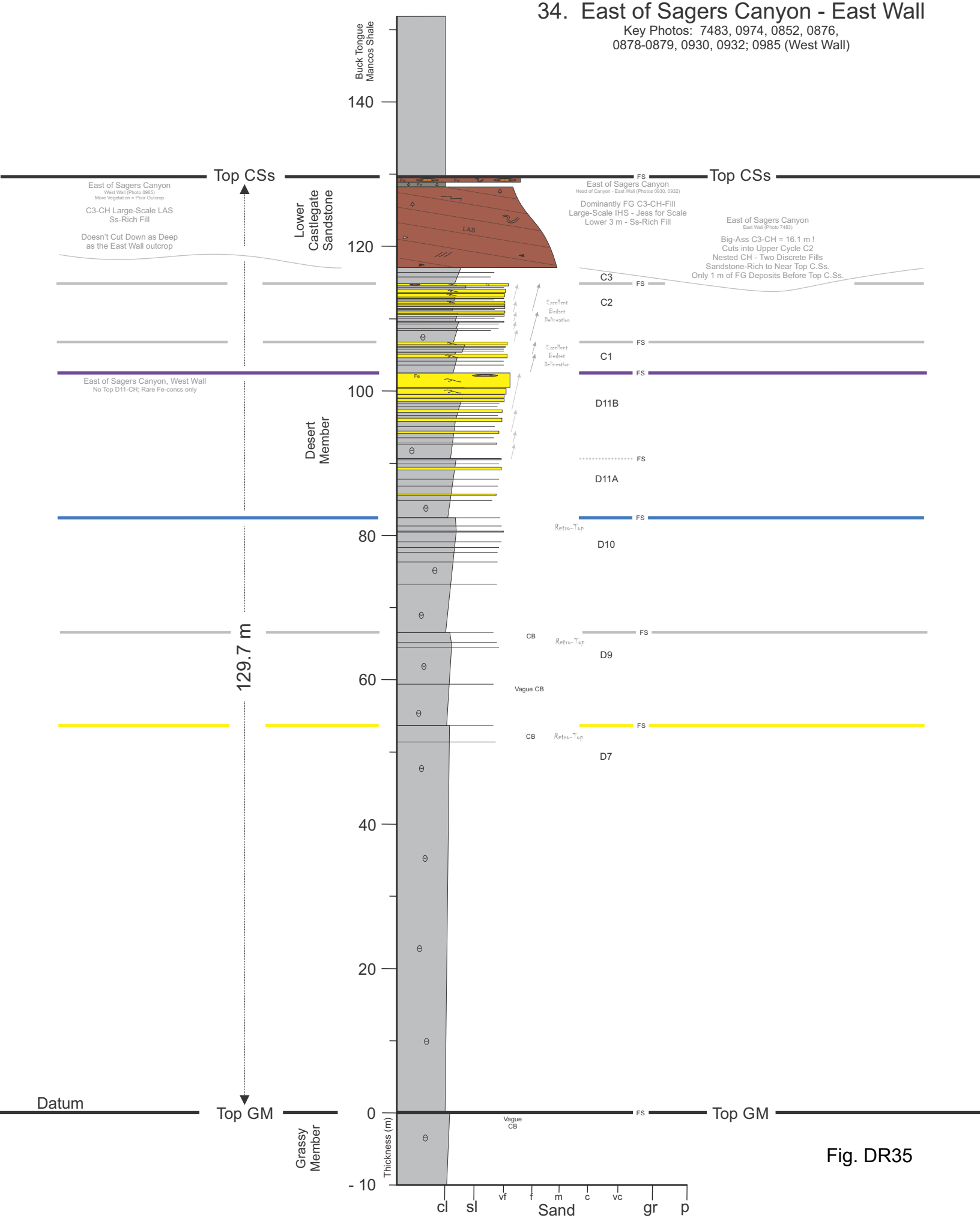


Fig. DR35

35. Pinto Wash - East Fork

Key Photos: 7767 (A), 9583 (B), 1036 (C), 1392 (D)
East Side Cyn: 1055, 1400, 1054, 1344
SE Bowl: 1040 (great lighting!)
East Wall: 1081, 1105, 1119, 1132

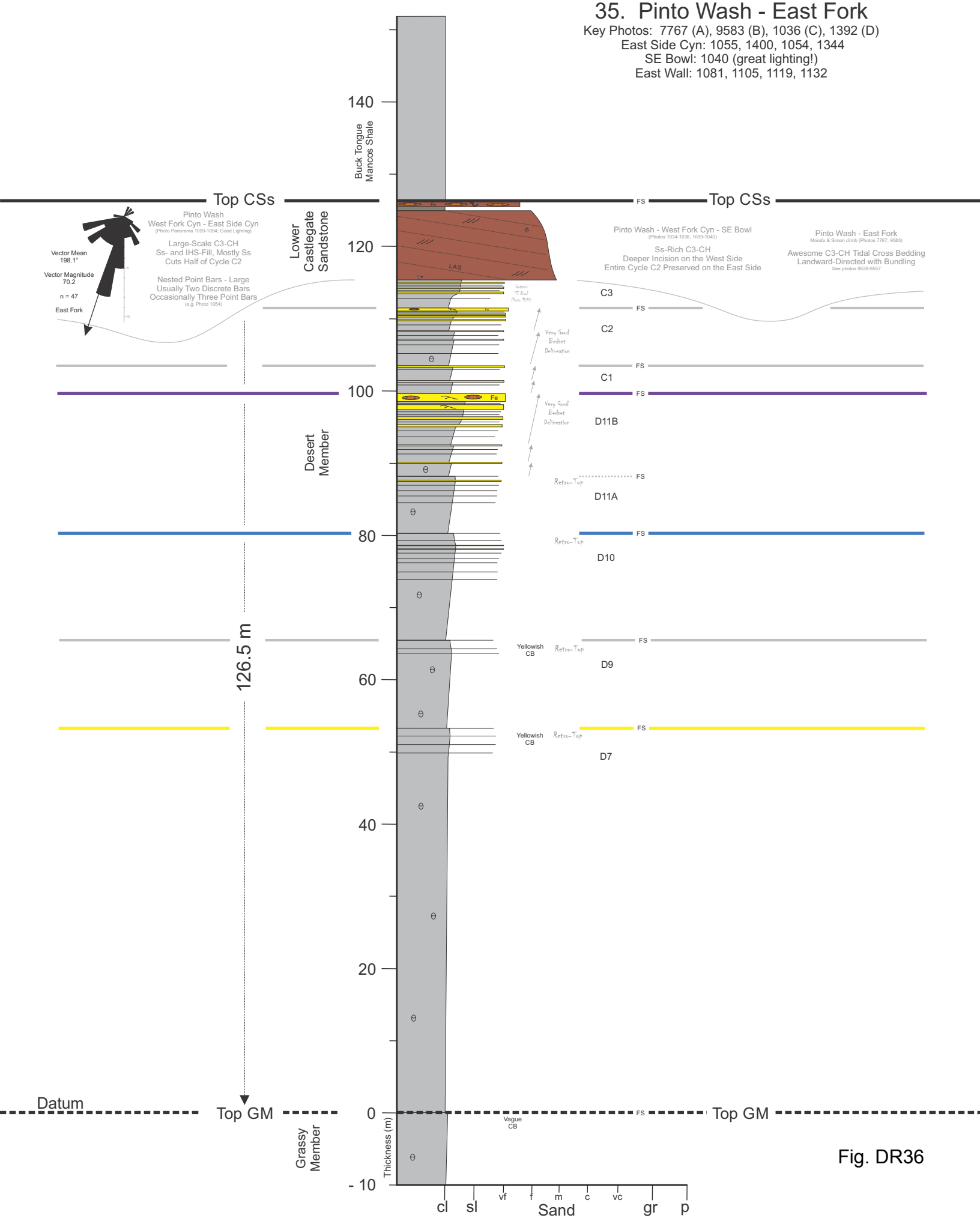


Fig. DR36

36. Nash Wash

Key Photos: 8354, 0382, 6646, 6610, 7147, 7540, 7805, 5851
S-BC equivalents: 0181, 0236 (BWC-WC); 0505, 0418 (BWC-EC)
Mst-filled CH-Top 11: 8195, 0299, 0302; 7588, 7558 (Bull Cyn)

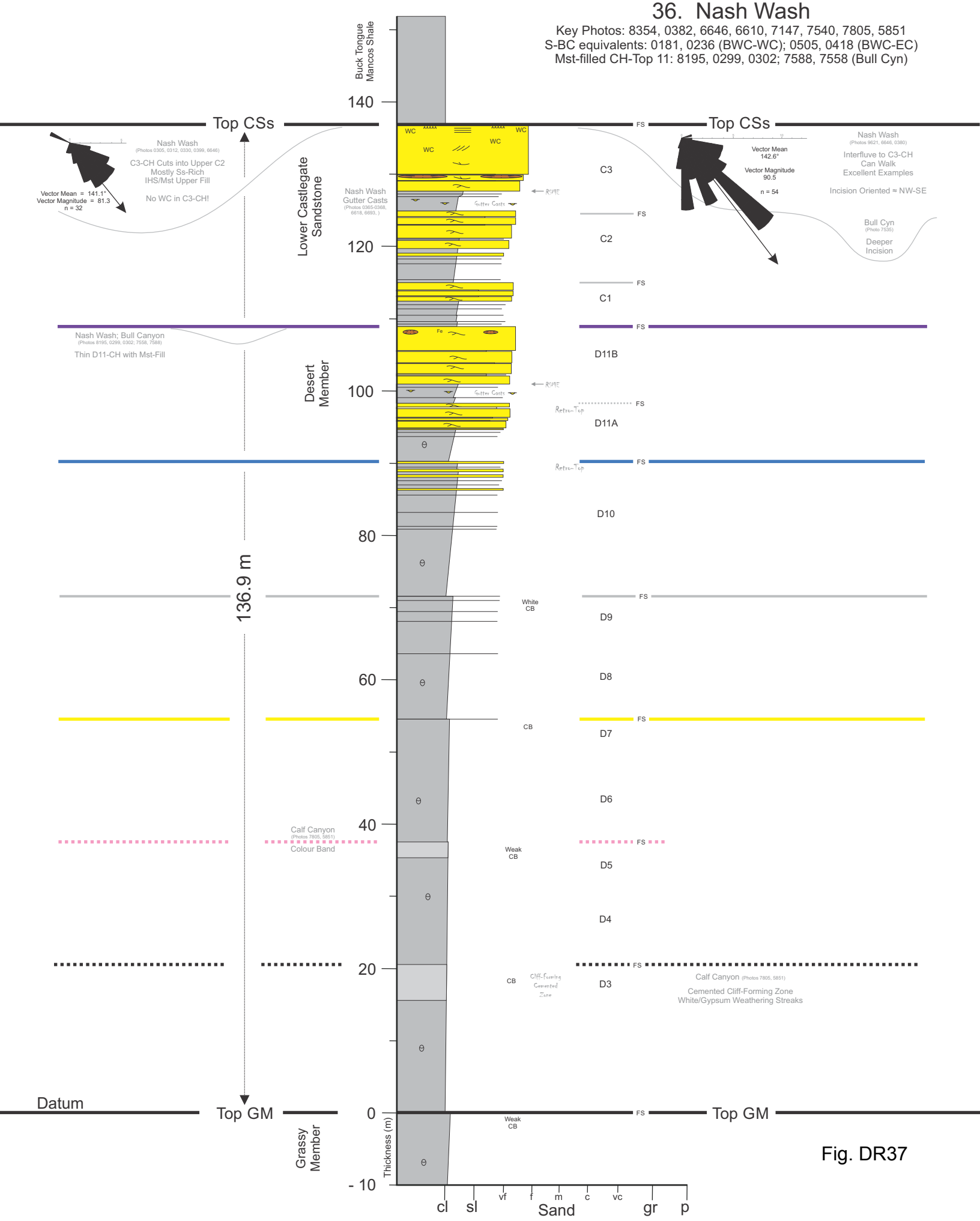


Fig. DR37

37. Calf Canyon

Key Photos: 0292, 7041/7031, 9643/6956/9673, 9697/7015, 9659/9657

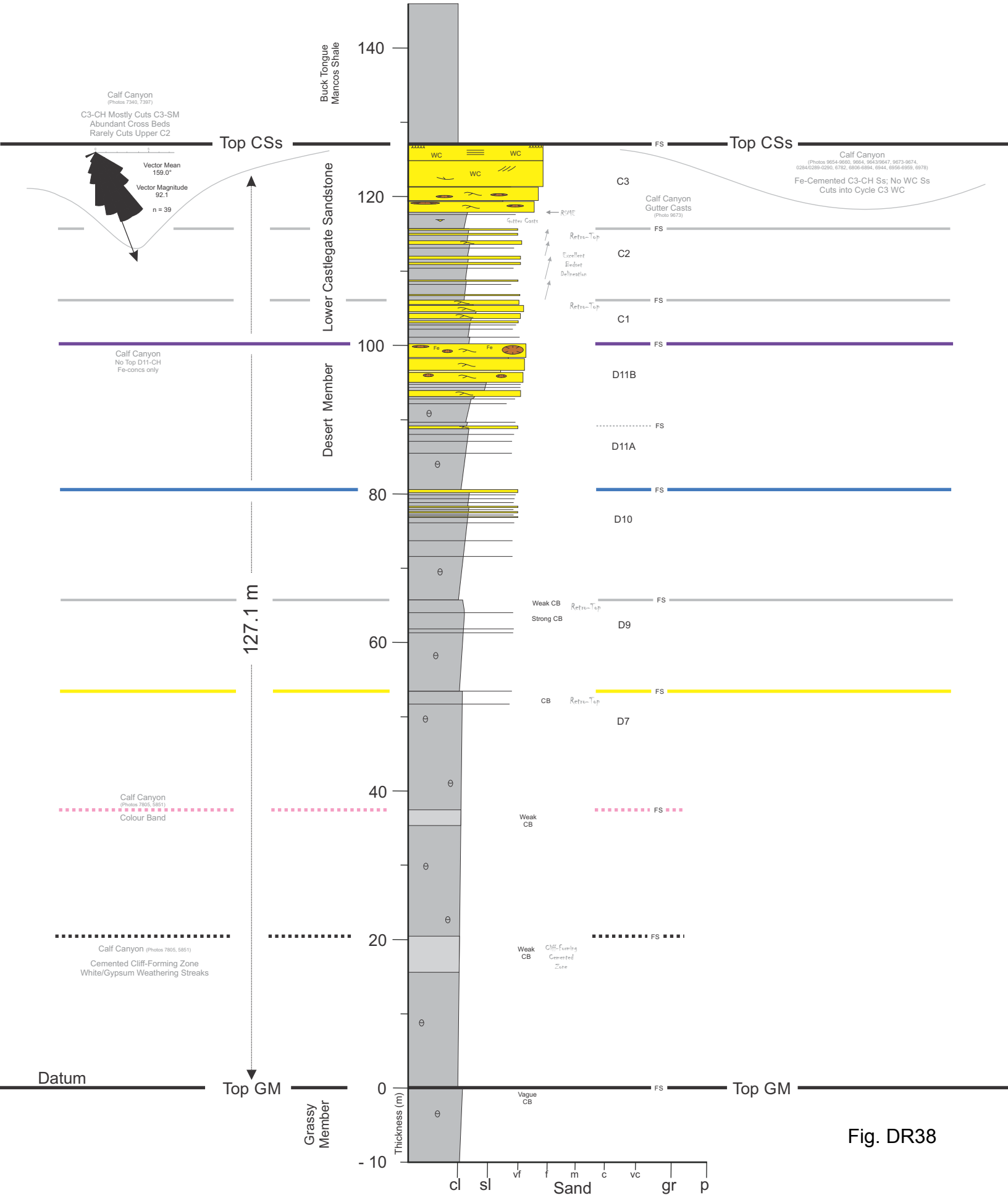


Fig. DR38

38. Strychnine Wash

Key Photos: (A) 9911, 5785, (B) 9891, (C) 7395, (D) 9713, 9715, 7298, (E) 7327, (F) 7335, (G) 7158, 7183, 7150, (H) 7306, 9771, 9758, 9787

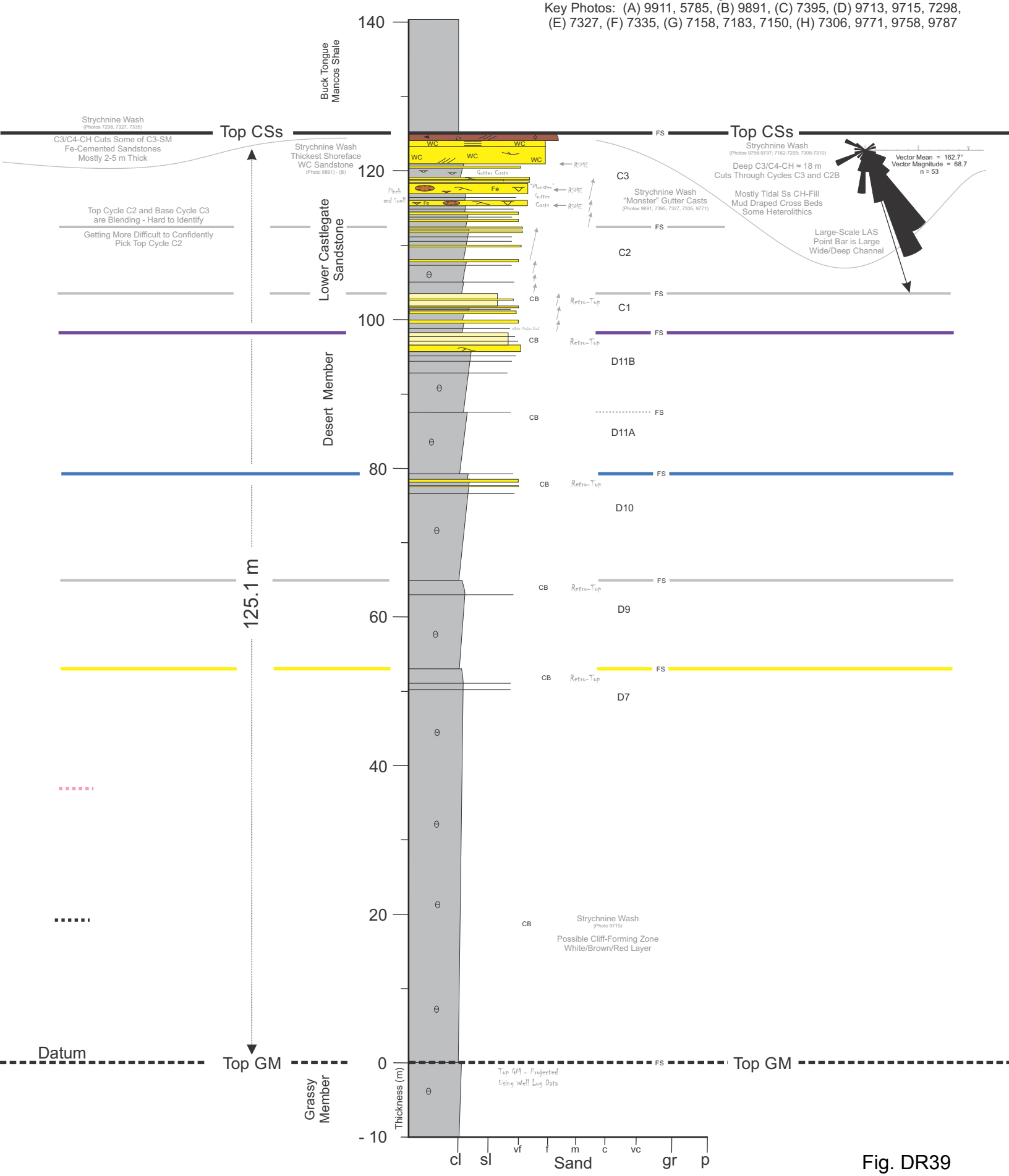


Fig. DR39

39. Big Hole Wash - West

Key Photos: (A) 9960, 7526, 7529, (B) 9969, (C) 9972, (D) 0051, 0015, 0018, (E) 9989

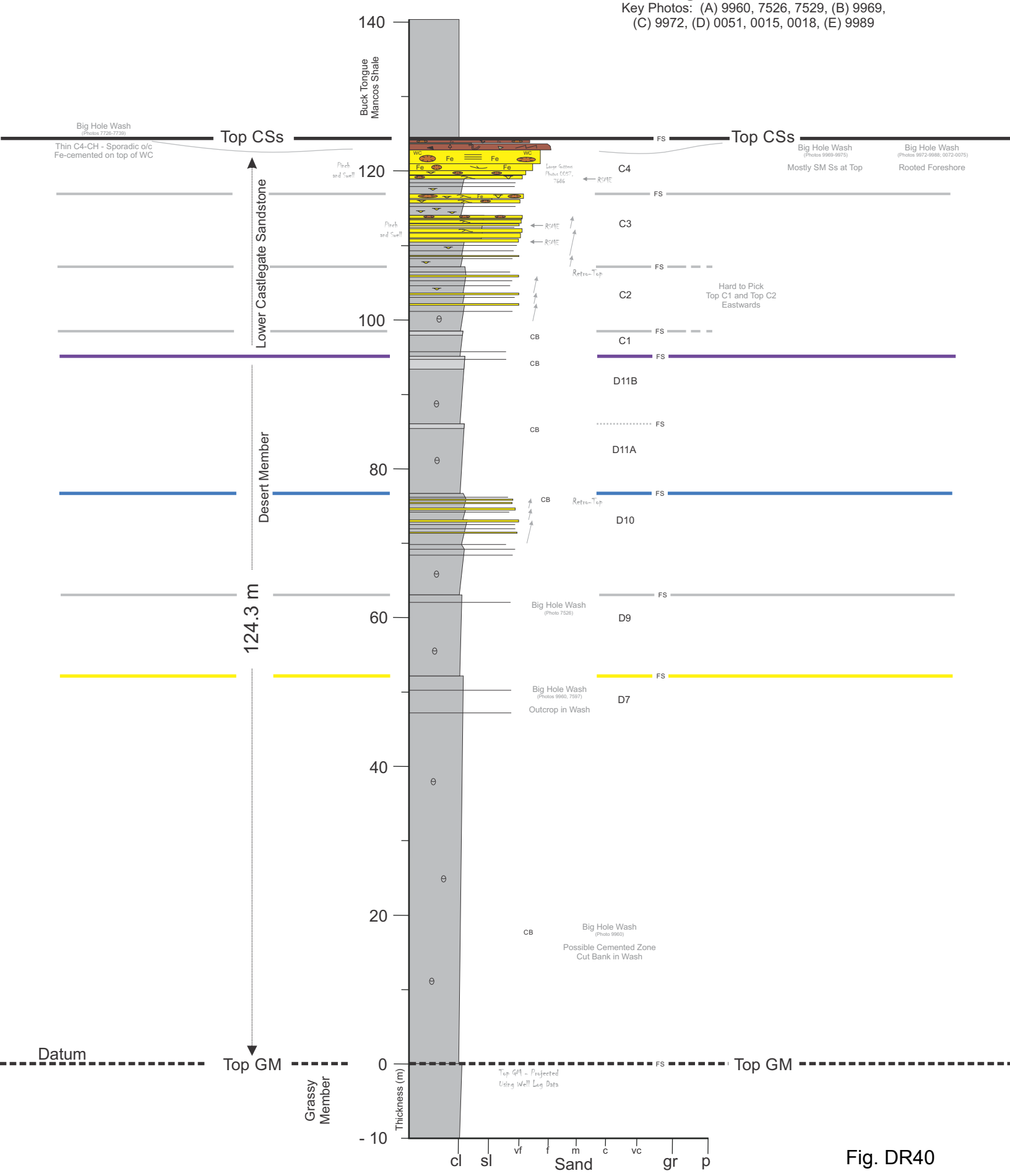


Fig. DR40

40. Big Hole Wash - East

Key Photos: (A) 0135, (B) 0102, 0111, 0114, (C) 7827, 7823 (D) 7858, (E) 0169, 0179

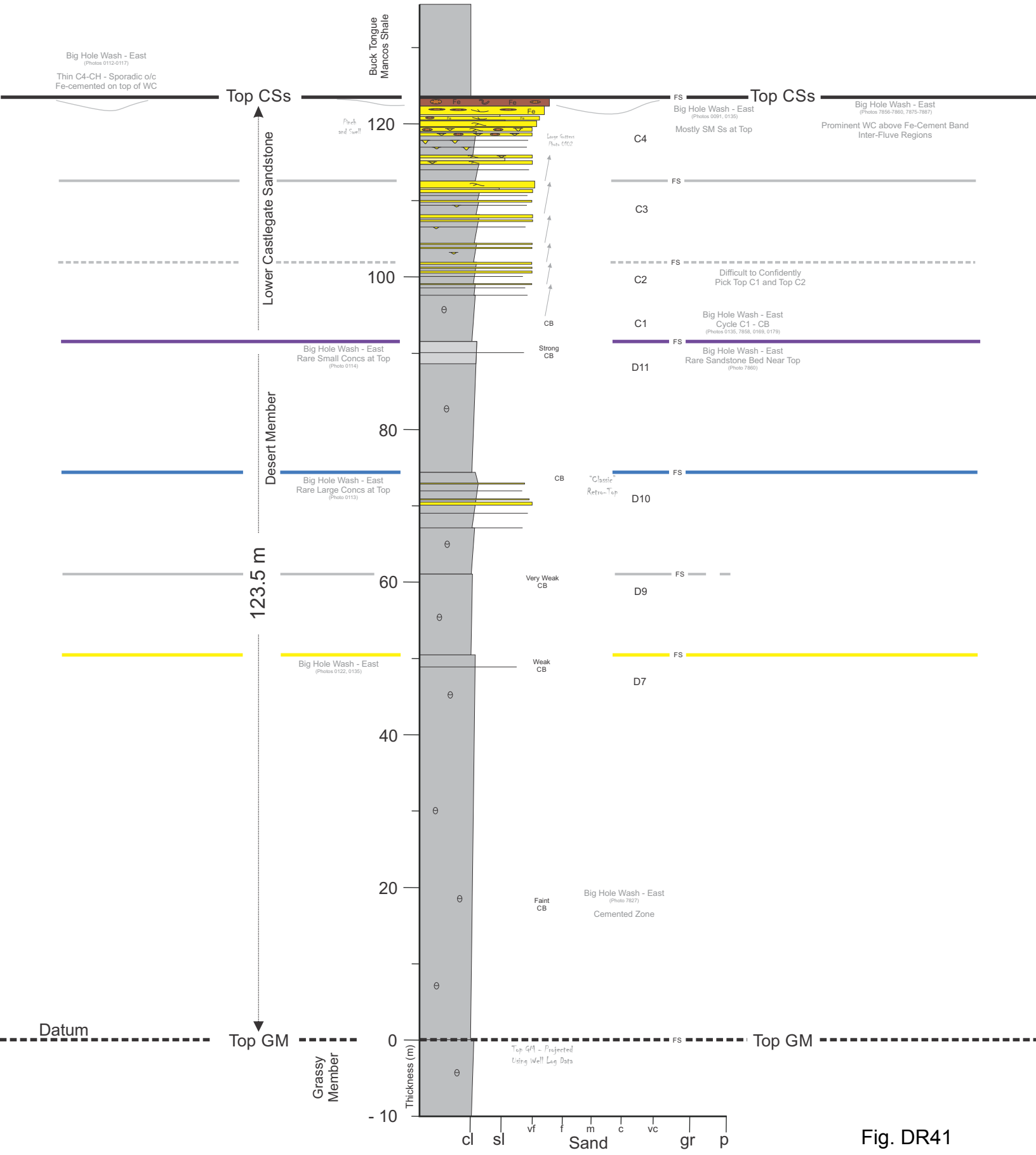


Fig. DR41

41. Corral Point - East

Key Photos: 8022/0195; West-to-East: 7859, 0179, 8515, 0191, 8513, 0194, 8015/8047/8048, 8503, 8029/8051, 8079/8053, 8498, 7947/8566/8567

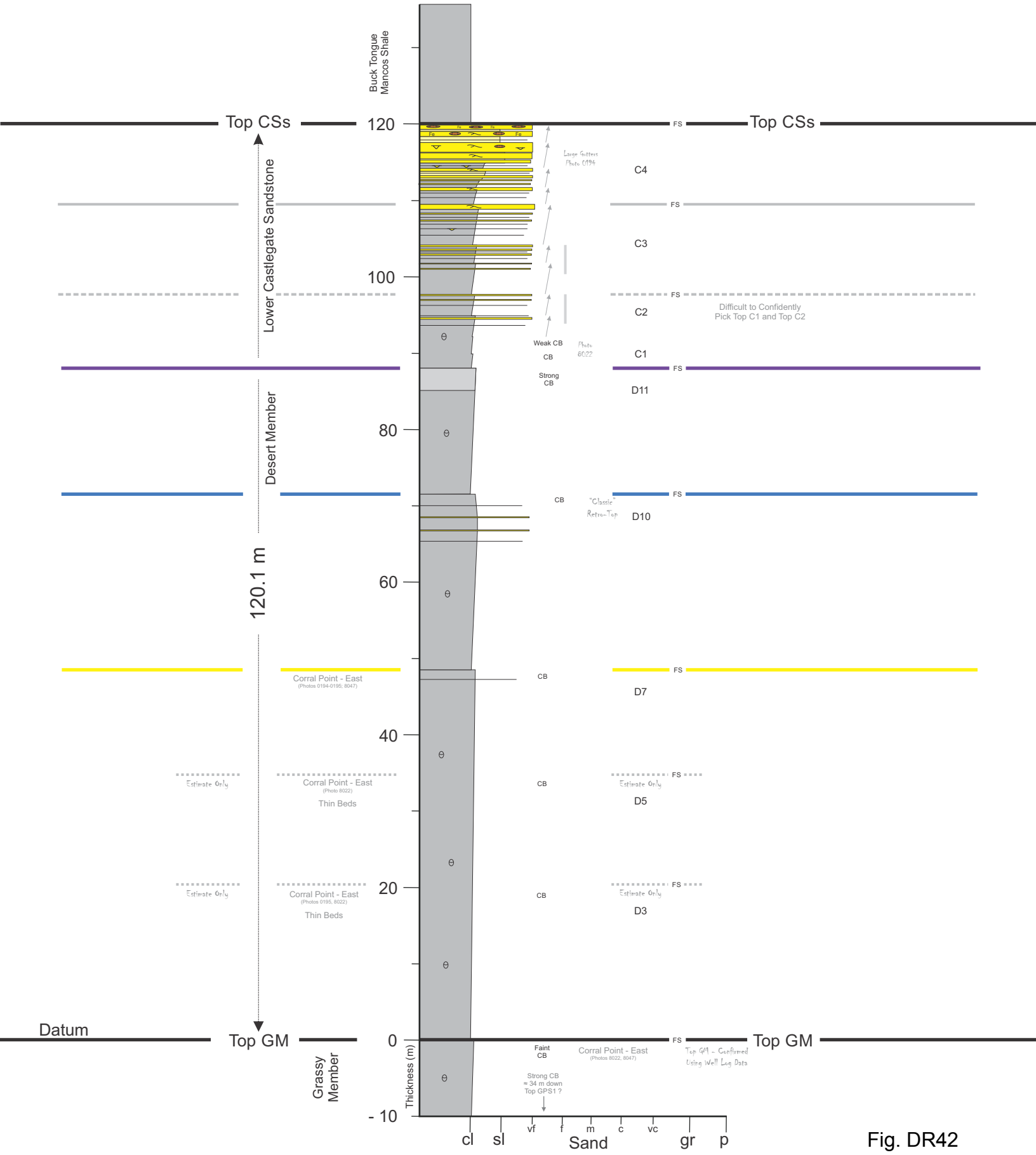


Fig. DR42

42. Long Canyon

Key Photos: 0727, 0246, 8445, 8450, 8455, 0254 (Cottonwood Wash - M1/S1)
0735, 0419, 0423, 0427, 8489, 8495 (Long Canyon - M2/S2)
8511, 0747, 8525 (Long Canyon East - M3/S3)

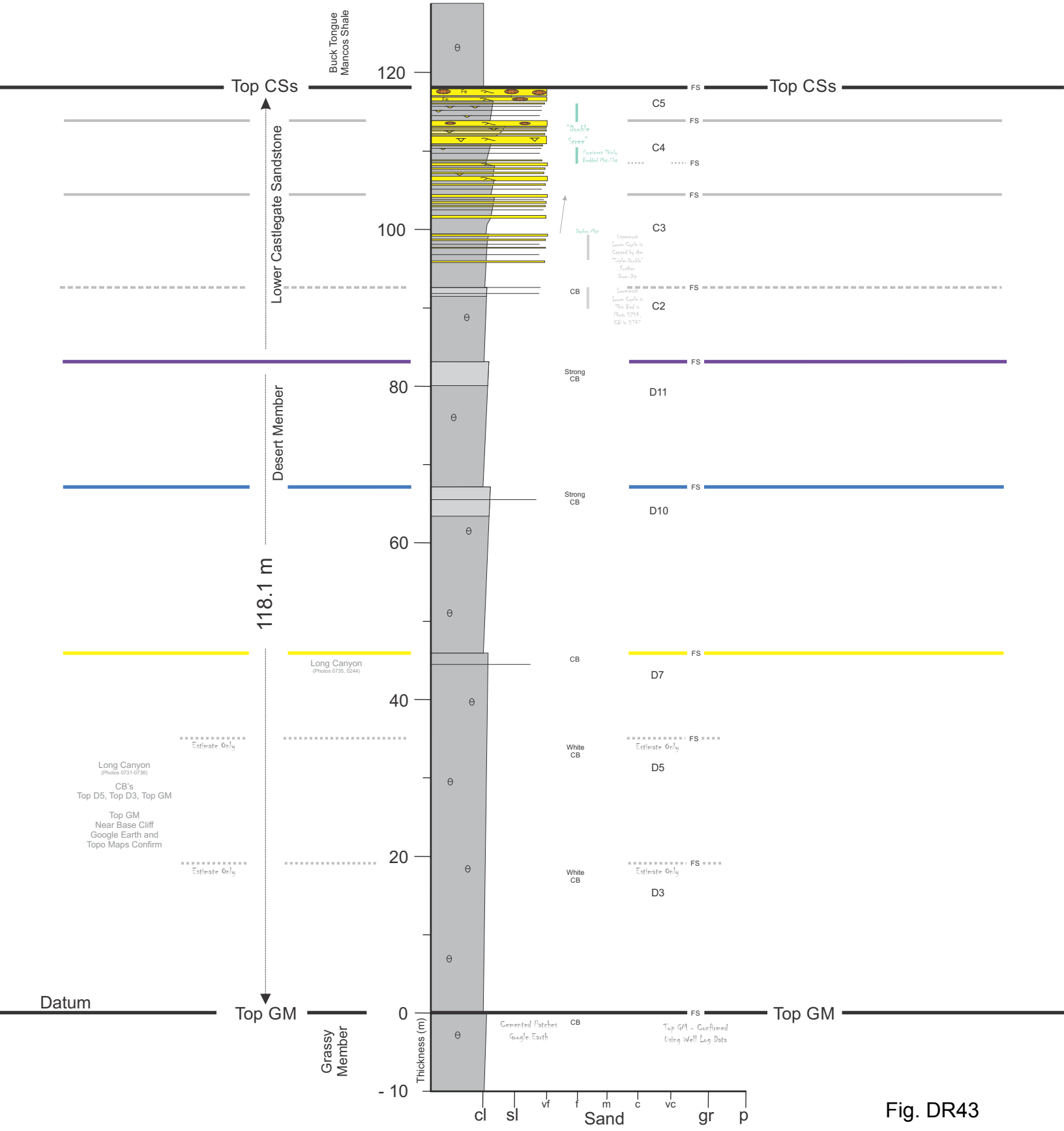


Fig. DR43

43. Sulphur Creek

Key Photos: (A) 8516, 0749, 8547 (Long Canyon East - M3/S3)
(B) 0752, 0753, 0448/0457, 0454, 8599 (Antone Wash - M4/S4)
(C) 0465, 0464 (Antone Wash - Btwn S4-M5)
(D) 8679, 8624/8669 (Sulphur Creek - M5)
(E) 0495 (Sulphur Creek - S5); (F) 8693, 8698 (Sulphur Creek)
(G) 0477, 0483/0487, 0472/8833 (Sulphur Creek)
(H) 8800, 0540/0542 (Sulphur Creek - North)
(I) 8803, 0588/0595, 0601/0605, 0552/8745/0557 (Westwater Ck Cyn)
(J) 0608(Westwater Creek Canyon - East)

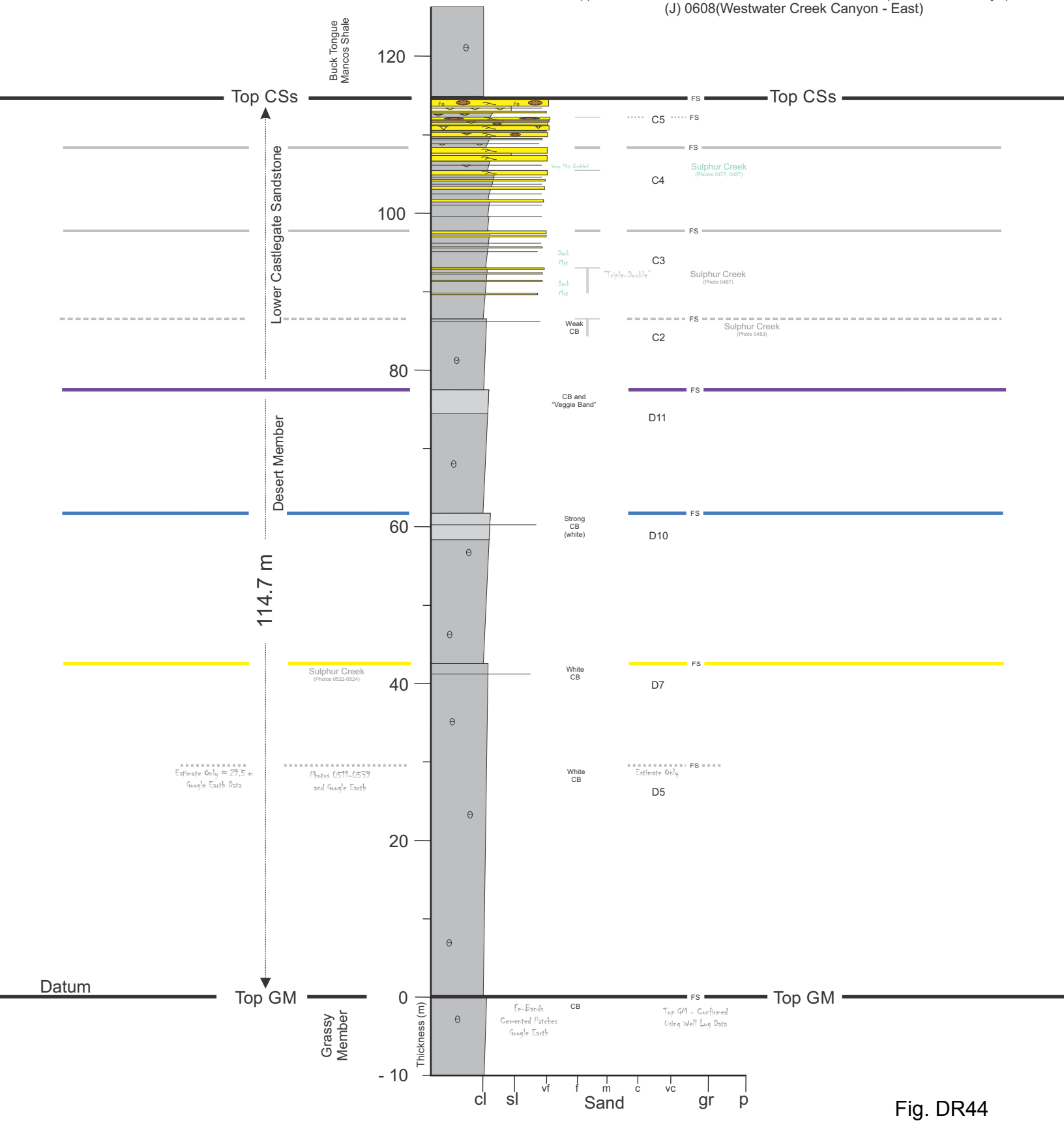


Fig. DR44

44. Bitter Creek

Key Photos: (A) 0670 (Bitter Creek-South)
(B) 0645, 0676, 8839, 8861 (BC-Lion Bench)
(C) 0630 (BC-North), (D) 0690 (BC-North)
(E) 0694 (BC-North); (F) 0707 (Prairie Canyon-West)
(G) 0713 (PC-West)
(H) 0721, 0731, 8932, 0746, 0774, 0748 (PC)

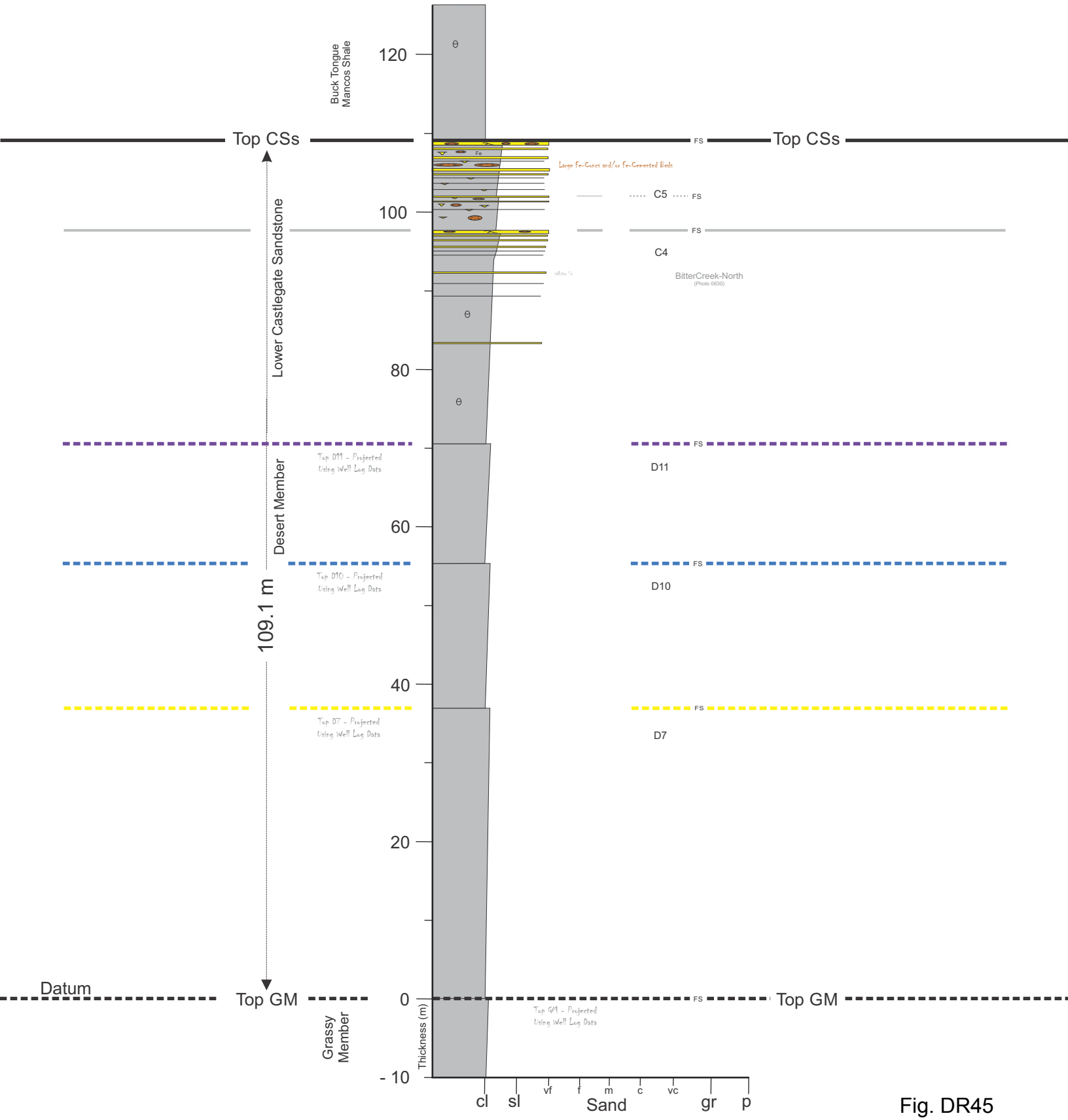


Fig. DR45

45. West Salt Creek

Key Photos: (A) 0735, 8946, 8932, 0761, 0764, 0757, 8956 (Prairie Canyon), (B) 9037, 9066 (West Salt Creek) (C) 9058, 9072 (WSC), (D) 9079, 0782, 0801, 8988, 9008, 9055 (WSC- Western Fe-Ooids) (E) 9068 (WSC-East); (F) 0828 (County Road 206-West) (G) 0858, 0809, 0835 (County Road 206-Main Fe-Ooids) (H) 0846, 0848 (County Road 206-East) (I) 0849, 0850 (Camp Gulch-West)

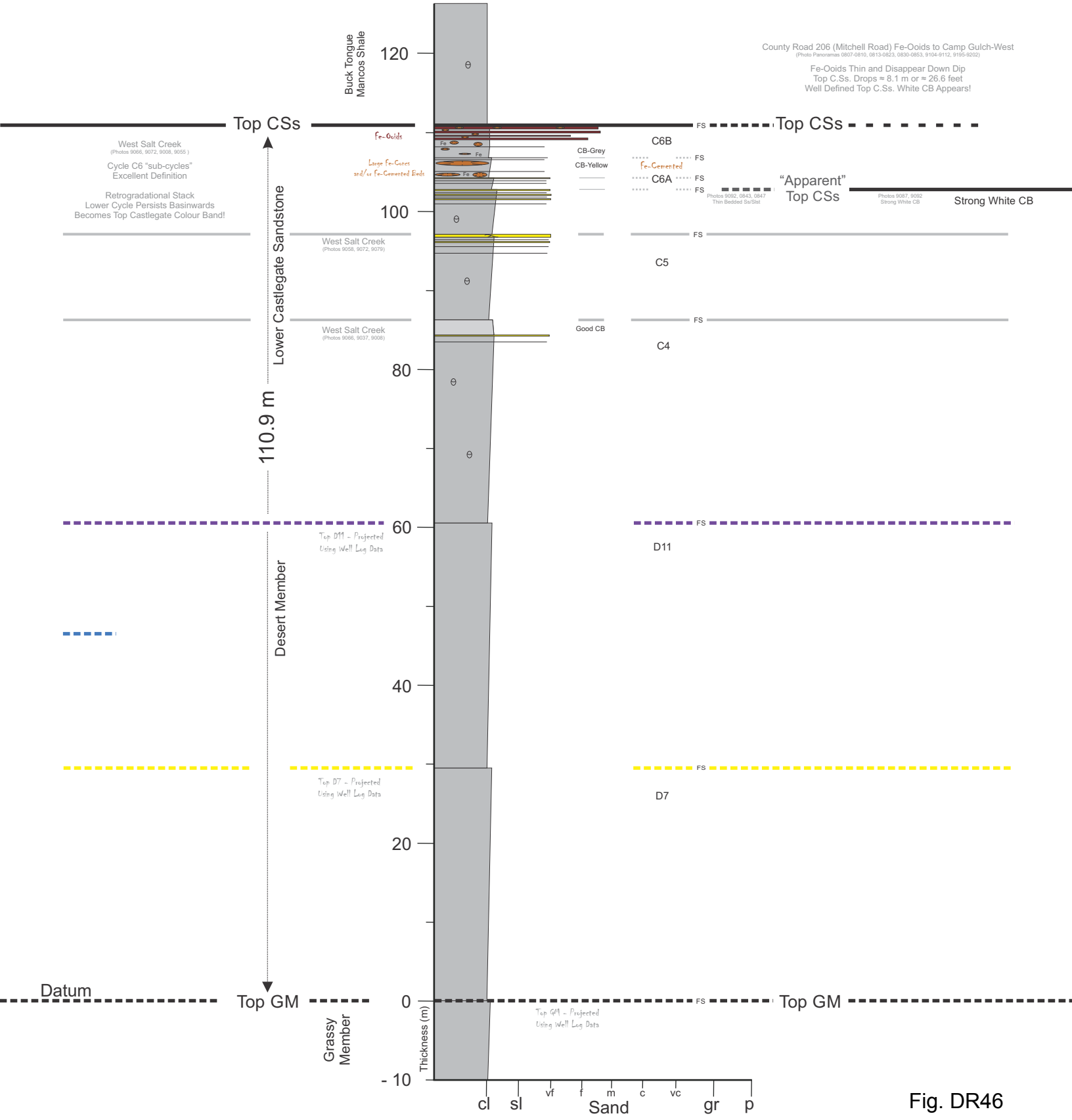


Fig. DR46

Legend

Horizontal/Planar Laminated	
Cross Bedded	
Swaley Cross Stratified	
Hummocky Cross Stratified	
Current Rippled	
Wave Rippled	
T_{bc}	Turbidite Bed-Bouma BC
Convolute Bedding	
Flame Structure	
Scour	
Concretion	
Pebbles	
Mudstone Clasts	
Bentonite Layer	
Fe	Iron-Bearing Cement
Spherulites	
CU	Coarsening Upward
FU	Fining Upward
LAS	Lateral Accretion Surface
IHS	Inclined Heterolithic Strata
WC	White-Capped Sandstone
FAF	Flat and Foreshore
FS	Flooding Surface
SB	Sequence Boundary
RSME	Regressive Surface of Marine Erosion

	Bioturbation
BI:0-6	Bioturbation Index (0-6)
N:G 30%	Net to Gross Ratio
C	*Chondrites*
D	*Diplocraterion*
O	*Ophiomorpha*
Pa	*Paleophycus*
Pl	*Planolites*
Sk	*Skolithos*
Te	*Teichichnus*
Ter	*Teredolites*
Th	*Thalassinoides*
	Plant Material
	Wood Fragments
	Coal Fragments
	Roots
BF	Bone Fragments
SF	Shell Fragments
ST	Shark's Teeth
	Sandstone
	Siltstone
	Mudstone
	Coal
	Scree Cover

Fig. DR47

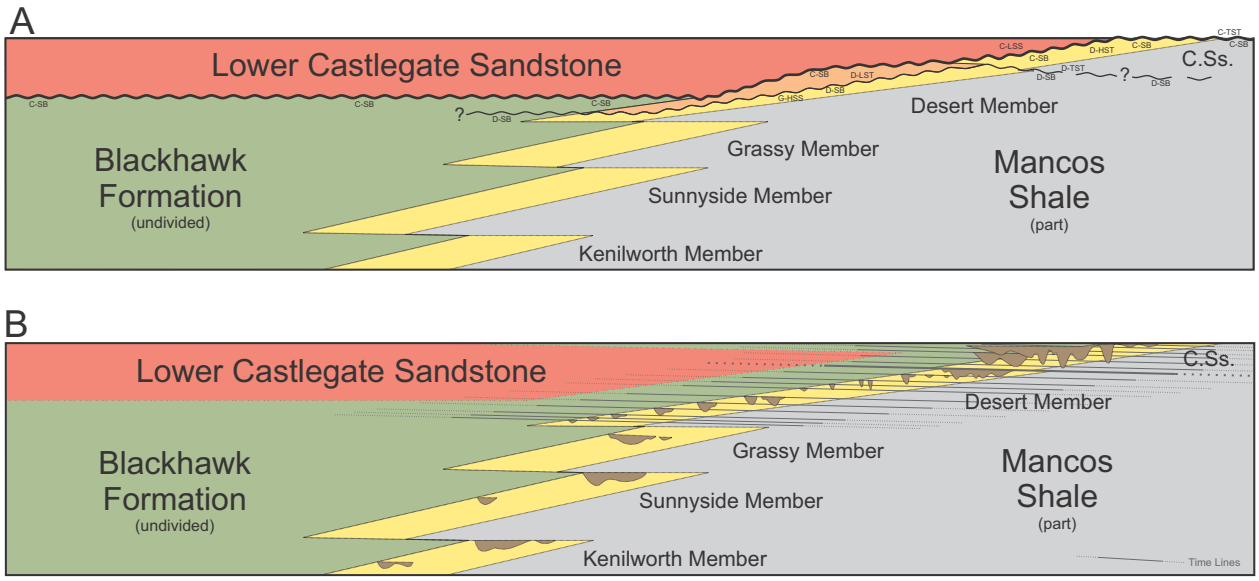


Figure DR48. Basic sequence stratigraphy. **(A)** Conventional sequence stratigraphic model of the Desert (D) Member to Lower Castlegate (C) Sandstone (C.Ss.) interval (Van Wagoner et al., 1990; Van Wagoner 1991, 1995). Third-order sequence boundaries (D-SB, C-SB) separate the terrestrial and shallow marine facies belts. HST (Highstand Systems Tract, LST (Lowstand Systems Tract), TST (Transgressive Systems Tract), G-HSS (Grassy Highstand Sequence Set), LSS (Lowstand Sequence Set). **(B)** Alternative sequence stratigraphic model (this study). Time lines connect the terrestrial and shallow marine facies belts (i.e. thick coal zones and flooding surfaces). Shoreface-incised channels are tidal-estuarine-fluvial and occur as discrete incisions in most Desert-Castlegate parasequences. Similar shoreface-incised channels exists in other members of the Blackhawk Formation.

1 - Shallow Marine Facies	*Grain Size; Sorting*	*Sedimentary Structures*	*Trace Fossils; BI*	*Sedimentary Architecture*	*Other Characteristics*	*Interpretation*
1A - Planar Laminated Sandstone	fL-mL sandstone. Well sorted.	Planar laminations.	Numerous *Macaronichnus* in places. BI (Bioturbation Index): 0-3	Offshore-directed low angle dips (2-5°). Flat top.	Densely rooted top. Individual root traces are up to 30 cm long. Most roots are 2-10 cm long and 1-2 mm wide. Bleached white sandstone at top: "white cap" (Young 1955; pg. 195). Overlain by fine-grained coastal plain and/or coal facies (3D, 3E, 3F), and underlain by cross bedded and/or SCS sandstones facies (1B, 1C).	Foreshore
1B - Trough Cross Bedded Sandstone	fL-mU sandstone. Well sorted.	Trough cross bedding.	Scattered *Macaronichnus*, and *Ophiomorpha*. BI: 0-2	Within a parasequence, the trough cross bedded sandstones are laterally continuous along depositional strike and confined within a narrow facies belt (≈ 1 km) along depositional dip.	Interbedded with SCS sandstones (Facies 1C). Usually overlain by planar laminated sandstones (1A) and underlain by HCS sandstones (1D). Cross beds reveal a mean paleoshoreline orientation of 215° (i.e. N35°E-S35°W). Vector magnitude = 56.5. n=299.	Upper Shoreface Fair Weather Deposition
1C - Swaley Cross Stratified (SCS) Sandstone	vfU-fU sandstone. Well to very well sorted.	Swaley cross stratification (SCS).	Infrequent *Ophiomorpha*. *Skolithos*, and *Schaubcylindrichnus*. BI: 0-2	Similar to the trough cross bedded facies, the SCS sandstones are laterally continuous along depositional strike (i.e. within a parasequence), but are confined within a narrow facies belt (≤ 1 km) along depositional dip.	Meter-scale swale lengths are common, with a maximum of 5 m. Swale amplitudes are mostly 15-70 cm. Interbedded with trough cross bedded sandstones (Facies 1B) and HCS sandstones (1D).	Upper Shoreface Storm Deposition
1D - Hummocky Cross Stratified (HCS) Sandstone	vfL-fU sandstone. Well to very well sorted.	Hummocky cross stratification (HCS).	Dominantly *Macaronichnus*, *Phycosiphon*, *Ophiomorpha*, and *Cylindrichnus*. Lesser *Teichichnus*, *Rosselia*, *Skolithos*, *Asterosoma*, *Palaeophycus*, *Chondrites*, *Scolicia*, *Conichnus*,	Laterally continuous along depositional strike. Wider facies belt compared to the trough cross bedded and SCS sandstones. Some HCS beds can be correlated for > 5 km down-depositional-dip. Beds become thinner and finer grained basinwards. Also show a progressive decrease in	HCS beds have meter-scale wavelength and decimeter-scale amplitude. Wavelengths and amplitudes show a progressive decrease upwards. Many beds are capped by wave-rippled to combined flow-rippled sandstones. Fining-upward successions are common. Some pin-striped carbonaceous-rich laminae in upper parts of beds.	Lower Shoreface to Inner Shelf Storm Deposition

			Planolites, and *Rhizocorallium*. BI: 0-4 Greater degree of bioturbation in the upper parts of most HCS beds.	hummock wavelength and amplitude basinwards. HCS sandstone package wedges-out offshore, transitioning into siltstones and mudstones (Facies 1F, 1G, 1H).	The majority of HCS beds are sharp-based and erosive. Rare gutter-casts. Interbedded with SCS sandstones (Facies 1C), wave-rippled sandstones (1E), sandy siltstone (1F), and silty mudstone (1G). SA-SR, elongated mudstone clasts (fine sand to pebble size) are observed in the basal parts of a few HCS beds. Mudstone clasts comprise 5-15 % of these beds, and are concentrated in discrete layers, or scattered throughout. Tightly cemented (Fe-, Ca-, and/or Si-rich), concretionary-like HCS beds cap the tops of some parasequences.	
1E - Wave-Rippled Sandstone	Mostly vfL-fL sandstone. Some coarse silt. Well to very well sorted.	Wave ripples. Rare combined flow ripples. Rare normally graded bedding.	*Asterosoma*, *Phycosiphon*, *Planolites*, *Teichichnus*, *Chondrites*, *Skolithos*, *Ophiomorpha*, *Cylindrichnus*, *Helminthopsis*, and *Schaubcylindrichnus*. BI: 0-4	Laterally continuous sandstone beds. Become progressively thinner and finer grained basinwards. Collectively the wave-rippled sandstone beds form a sheet-like geometry that wedges/thins both landwards and basinwards.	Wave-rippled sandstones occur both as discrete beds and at the top of many HCS sandstone beds (Facies 1D). The latter is a gradational facies contact. Almost all beds are 2-10 cm thick and are sharp-based. Interlaminated mudstone occur infrequently. Interbedded with sandy siltstone (1F), silty mudstone (1G), and dark grey mudstone (1H).	Lower Shoreface to Inner Shelf Mixed Fair Weather and Storm Deposition
1F-i - Moderate-to-High BI Sandy Siltstone	Coarse-grained siltstone. Varying amounts of vfL-vfU sand and mudstone. Moderately to moderately well sorted. Thoroughly mixed silt, sand and clay because of the moderate-to-high degree of bioturbation.	Occasional wave ripples, combined flow ripples, and normally graded beds.	Mainly *Asterosoma*, *Chondrites*, *Phycosiphon*, *Ophiomorpha*, *Teichichnus*, *Planolites*, and *Cylindrichnus*. Also *Schaubcylindrichnus*, *Skolithos*, and *Thalassinoides*. Scattered *Helminthopsis*, *Scolicia*, *Rosselia*, *Arenicolites*, and	Sheet-like geometry. Facies package wedges-out both landwards and basinwards. Laterally continuous along depositional strike. Dominates the medial parts of a parasequence, basinwards of the main HCS sandstones facies zone.	Interbedded with low BI sandy siltstone (Facies 1F-ii), silty mudstone (1G), wave-rippled sandstone (1E), and HCS sandstone (1D). More abundant than 1F-ii. Rare carbonaceous-rich laminae. Phyto-detrital. Finely disseminated plant debris. Sparse mudstone and coal clasts: medium sand to pebble sized, SA-SR. With minor amounts of fU-mU sand.	Lower Shoreface to Mid-Shelf Rarely Fresh Water Influenced

			Zoophycos. Scattered fugichnia. BI: 3-6		Rare synaeresis cracks. Beds are 2-60 cm thick.	
1F-ii - Low BI Sandy Siltstone	Coarse-grained siltstone. Varying amounts of vfL-vfU sand and mudstone. Moderately to moderately well sorted. Discretely bedded-laminated. Segregated by grain size. Abundant pin-striped mudstone, siltstone and vfL-vfU sandstone laminae. Silt, sand and clay form discrete laminae and/or beds because of the low degree of bioturbation.	Numerous wave ripples. Some combined flow ripples and normally graded beds.	Dominantly *Chondrites*, *Planolites*, *Phycosiphon*, and *Asterosoma*. Lesser *Teichichnus*, *Ophiomorpha*, *Cylindrichnus*, *Skolithos*, *Thalassinoides*, *Schaubcylindrichnus*, *Scolicia*, *Helminthopsis*, and *Zoophycos*. Rare escape traces/fugichnia. BI: 0-3	Sporadic occurrence vertically and laterally. Not as volumetrically abundant as Facies 1F-i. Overall sheet-like geometry, when including the interbedded facies.	Interbedded with moderate-high BI sandy siltstone (Facies 1F-i), which is in greater abundance compared to the low BI sandy siltstone. Also interbedded with Facies 1D, 1E, and 1G. Abundant synaeresis cracks. Siltstone and sandstone beds are 1-4 cm thick and are sharp-based. Bed tops are sharp-to-gradational. The latter is due to the mild bioturbation, coupled with a fining-upward grain size trend. A few carbonaceous-rich laminae.	Lower Shoreface to Mid-Shelf Frequently Fresh Water Influenced
1G-i - Moderate-to-High BI Silty Mudstone	Mudstone. vfL-vfU sandstone. Coarse siltstone. Moderately to moderately well sorted. Varying amounts of vfL-vfU sand and coarse silt thoroughly mixed into the background mudstone.	Rare wave ripples, combined flow ripples, and normally graded beds.	Primarily *Phycosiphon*, *Chondrites*, *Teichichnus*, *Planolites*, *Asterosoma*, *Schaubcylindrichnus*, *Cylindrichnus*, and *Scolicia*. Subordinate *Thalassinoides*, *Rhizocorallium*, *Ophiomorpha*, *Conichnus*, and *Palaeophycus*. Isolated fugichnia (escape trace). BI: 3-6	Laterally continuous, sheet-like geometry characteristic of distal parasequences. Grades up-depositional-dip into moderate-to-high BI sandy siltstone (Facies 1F-i) and down-depositional-dip into dark grey mudstone (1H). Facies belt 1G is correlatable for many kilometers, both along depositional strike and dip, within each parasequence.	Interbedded with low BI silty mudstone (Facies 1G-ii), sandy siltstone (1F), wave rippled sandstone (1E), and dark grey mudstone (1H). Rare and disseminated sand-sized phyto-detrital fragments (i.e. plant material). Also a few SA, elongated, sand-to-granule sized coal clasts. Isolated synaeresis cracks.	Lower Shoreface to Outer-Shelf Sporadically Fresh Water Influenced

1G-ii - Low BI Silty Mudstone	Mudstone. vfL-vfU sandstone. Coarse siltstone. Moderately to moderately well sorted. Discrete laminae and thin beds (1-3 cm thick) of very fine-grained sandstone and coarse siltstone. Minor mixing of sand and silt into the mudstone.	Abundant wave ripples. Lesser combined flow ripples and normally graded beds. Pin-striped laminae of mudstone, siltstone and sandstone.	Predominantly *Chondrites*. Minor *Planolites*, *Teichichnus*, *Phycosiphon*, *Asterosoma*, and *Schaubcylindrichnus*. Sparse fugichnia. BI: 0-2	Patchy occurrence within a thicker package of moderate-to-high BI silty mudstone (Facies 1G-i), comprising approximately 20% of Facies 1G. As per above, this facies belt is laterally continuous along depositional strike and dip within the distal portions of each parasequence.	Interbedded with moderate-high BI silty mudstone (Facies 1G-i), wave rippled sandstone (1E), and low BI sandy siltstone (1F-ii). Sharp contacts are observed between the interbeds. Plentiful synaeresis cracks. Rare fU-mL sand laminae. Even rarer dispersed or intermixed fU-mL sand. Isolated carbonaceous-rich laminae (i.e. finely disseminated phyto-detritals/plant matter).	Lower Shoreface to Outer-Shelf Fresh Water Influenced
1H - Dark Grey Mudstone	Dark grey mudstone. Some coarse silt and vfL sand. Moderately well to well sorted. Coarse silt and very fine-grained sand concentrated in laminae or rarely dispersed throughout the background mudstone.	Rare wave ripples and normally graded beds. Predominantly laminated, occasionally very thinly bedded (1.0-1.5 cm thick).	Mostly *Chondrites*. Infrequent *Phycosiphon*, *Asterosoma*, *Planolites*, and *Schaubcylindrichnus*. Rare escape traces (fugichnia). BI: 0-6	Laterally continuous, sheet-like geometry in distal portions of each parasequence. Transitions up-depositional-dip into silty mudstone (Facies 1G).	Fe-rich carbonate-cemented concretions are concentrated along distal flooding surfaces. Uncommon synaeresis cracks. Mudstone is dark grey to grey.	Inner-Shelf to Outer-Shelf Rarely Fresh Water Influenced
2 - Channel Facies	*Grain Size; Sorting*	*Sedimentary Structures*	*Trace Fossils; BI*	*Sedimentary Architecture*	*Other Characteristics*	*Interpretation*
2A - Cross Bedded Sandstone	fL-cU sandstone. Moderately to moderately well sorted. Interlaminated with carbonaceous-rich mudstone in places.	Dominantly trough cross bedding, lesser planar tabular cross bedding. Sparse herringbone cross bedding. Rare double mud drapes and rhythmically laminated cross bedding (tidal bundles?).	Rare *Teredolites*; BI (Bioturbation Index): 0-1	Cross bedded sandstones are usually confined within channel-fills. Lens- to sigmoidal-shaped, bar-form geometry. Single and multi-story channel-fill packages are observed. Bar-forms are a variety of sizes (i.e. width 8-300 m; thickness 2-10 m), and exhibit both lateral and downstream accretion. In general, bar-form size	Beds are 10-70 cm thick. Sharp-based. Base of facies erosively overlies shallow marine sandstones in some localities. Cross beds reveal a mean transport direction of 127° (i.e. E37°S). Vector magnitude = 63.8. n=5,966. Abundant A-SR, sand-to-pebble sized coal clasts, concentrated in layers or scattered throughout. Comprise up to 25 % of Facies 2A in places. SA-SR mudstone clasts occasionally observed with the coal clasts. These are also sand-to-pebble sized, and for the most part, consist of carbonaceous-rich	Fluvial Channel; Tidal-Fluvial Channel

				decreases landwards. The widest and thickest bar-forms are usually within 2 to 5 km of the penecontemporaneous shoreline.	mudstone and shale (Facies 3D and 3E). Numerous finely disseminated plant fragments resembling coffee grounds (medium silt to coarse sand sized). Mainly as discrete laminae within cross bedded sandstones, but also scattered within the facies. Rare bone fragments (dinosaur?). Cross bedded sandstones are interbedded with many different channel facies, but predominantly with convolute bedded sandstone (Facies 2B). Prolific channel-fill facies.	
2B - Convolute Bedded Sandstone	fL-cU sandstone. Moderately to moderately well sorted.	Convolute bedding. Gently to tightly folded. Vertical dips occur in places.	Scarce *Palaeophycus*, and *Psilonichnus*. BI: 0-1	Within channel. Abundant facies within the channel-fill successions. Single and multi-story channel-fills.	Beds are 15-80 cm thick. Abundant A-SR, sand-to-pebble sized coal and mudstone clasts. Laminations of carbonaceous matter are common. Some elongated wood fragments. Mostly interbedded with cross bedded sandstone (Facies 2A). Uppermost Castlegate Sandstone is often convolute bedded and tightly cemented. Fe-rich carbonate cements impart a distinct brown-red colour in these uppermost beds. Plentiful channel-fill facies.	Fluvial Channel; Tidal-Fluvial Channel
2C - Planar Laminated Sandstone	fL-mU sandstone. Moderately well sorted.	Planar laminations – horizontal.	Rare *Palaeophycus*. BI: 0-1	Within channel. Comprises minor amount of bar-form, sigmoidal geometries in single- and multi-story channel-fills.	Beds are 10-30 cm thick. Sharp base and top. Moderate amounts of silt-to-fine sand sized, finely-disseminated plant material concentrated in laminae or thin beds (1-2 cm thick). Infrequent sand-to-granule sized, A-SA, elongated, coal and mudstone clasts. Rare wood fragments. Interbedded with cross bedded (Facies	Fluvial Channel; Tidal-Fluvial Channel

					2A) and convolute bedded (2B) sandstones. Scarce channel-fill facies.	
2D - Current Rippled Sandstone	vfU-mL sandstone. Isolated beds with intermixed mU-cL sand. Moderately well to well sorted. Interlaminated with carbonaceous-rich mudstone. Rhythmically laminated in places.	Current ripples. Rare climbing ripples, with a shallow angle of climb.	Sporadic *Macanopsis*, and unknown traces. BI: 0-1	Within channel. Mostly associated with thinner and narrower single story channel-fill deposits. Occasionally observed in large-scale IVF-IHS deposits at the top of the Desert Member and Castlegate Sandstone.	Abundant laminae of finely comminuted (i.e. silt-to-fine sand size) plant material. Numerous SA-SR sand-to-granule sized coal clasts. Mudstone clasts are sparse. Beds are 5-60 cm thick. Occasional roots (rhizoliths). Moderately abundant channel-fill facies. Interbedded with Facies 2E, 2F and 2G. Sharp contacts between the facies.	Fluvial Channel; Tidal-Fluvial Channel
2E - Gently-Dipping Interbedded Sandstone and Mudstone (IHS)	Bimodal grain size distribution. Sandstone beds are mainly fL-mU sand. Minor cL-cU sand. Mudstone beds have near equal amounts of clay and silt, with some intermixed coarse silt and very fine sand. Mudstones are dark grey to black reflecting their carbonaceous-rich character. All beds and laminae dip at a low angle, between 2-8°. Decimeter-to-meter-scale sets or packages have consistent dips and dip directions. These are abruptly overlain by sets with different dips and dip directions. Always low angle dips, but dip directions vary 20-80° per sets. Overall, this facies is moderately well sorted.	Dominantly inclined heterolithic strata (IHS). Beds are sharp-based and 1—10 cm thick. Rhythmically laminated sandstone and carbonaceous-rich mudstones. Upward, progressive-patterned thinning and thickening of laminations, resembling tidal rhythmites. Sandstone beds are dominantly current rippled or massive, with trough cross bedding, normal grading, planar laminations, convolute bedding and wave ripples. Rare double	Uncommon *Chondrites*, and *Schaubcylindrichnus*. Rare *Teredolites*-bored wood fragments. BI: 0-2	Within channel. Large-scale lateral accretion. Desert Member parasequence D11 has IHS accretion sets 200-350 meters wide and 8-12 m thick throughout the Horse Heaven to Thompson Canyon region. Similarly large-scale IHS accretion sets are observed in the uppermost Lower Castlegate Sandstone from Blaze Canyon to Pinto Wash, and in the mid-Desert Member interval (D6 parasequence) at Hatch Mesa. Single and multi-story channel-fills.	Carbonaceous-rich laminae and A-SR, sand-sized coal clasts occur throughout. Isolated root traces, especially near the top of the IHS channel-fill successions. This facies is confined to large-scale, channel-fill successions within 10 km of the penecontemporaneous shoreline. The best examples are in the upper parts of the Desert Member and Lower Castlegate Sandstone, where deep and broad channels incise into the penecontemporaneous foreshore-shoreface sandstones.	Estuarine-Tidal Channel

		mud drapes and rhythmically laminated cross bedding (i.e. tidal bundles) in places.				
2F - Carbonaceous-Rich Sandstone	fL-cU sandstone. Moderately sorted. Interbedded-interlaminated carbonaceous-rich mudstone, up to 20 % of the facies.	Variety of sedimentary structures: massive, current ripples, planar laminations, convolute bedding, and normal grading. Rhythmically laminated in places, with patterned alternations of carbonaceous-rich and sandstone-rich laminations.	Isolated *Palaeophycus*, unknown traces, *Planolites*, *Chondrites*, and *Skolithos*. BI: 0-3	Within channel. Comprises minor-to-moderate amounts of sigmoidal bar-form geometries in both single-storey and multi-story channel-fill complexes. Occurs at different levels throughout a channel-fill: basal lag deposits, mid-channel-fill, and uppermost terminal bar-form-fill.	Numerous A-SR sand-to-pebble-sized coal fragments and silt-to-sand-sized phyto-detritals. The latter are scattered throughout the facies or are concentrated as discrete laminae. Total carbonaceous matter is 15-25 %. Sporadic SA-SR, sand-to-granule sized carbonaceous-rich mudstone clasts. Some basal lag deposits consisting of mL-cU sand, coal and mudstone clasts, with an upward decrease in grain size. Basal lags are 5-10 cm thick. Rare synaeresis cracks. Interbedded with a variety of channel-fill facies, such as cross bedded sandstones (Facies 2A), convolute bedded sandstones (2B), and mudstone-clasts pebble breccia (2I).	Fluvial Channel; Tidal-Fluvial Channel
2G - Carbonaceous-Rich Siltstone	Carbonaceous-rich fine-to-coarse siltstone, with interlaminated carbonaceous-rich mudstone and very fine-grained sandstone. Moderately sorted.	Laminae are massive, normally graded or weakly current rippled. Predominantly rhythmically laminated. Near equal amounts of mudstone and siltstone, with lesser amounts of sandstone. Pin-striped laminations (1-3 mm thick) are common. Vertical trends of thickening and thinning laminae are frequently recorded.	Scattered unknown traces, *Chondrites*, and *Planolites*. BI: 0-3	Within channel-fill successions. Generally confined to the upper and finer-grained portions of lateral accretion sets.	Abundant phyto-detritals: silt-to-fine sand sized. Rare A-SA, sand-to-granule sized, elongate coal fragments. Some Fe-rich cements: thin beds and cm-scale diameter nodules. Occasional synaeresis cracks. Interbedded with carbonaceous-rich sandstone (Facies 2F) and carbonaceous-rich mudstone (2H).	Fluvial Channel; Tidal-Fluvial Channel

		Some starved current ripples.				
2H - Carbonaceous-Rich Mudstone	Dark grey to black mudstone, with lesser amounts of silt and very fine sand. Moderately well sorted.	Massive. Sparse normal grading.	Rare *Chondrites*, and *Schaubcylindrichnus*. BI: 0-2	Within channel-fill successions. Predominantly observed in the uppermost parts of channel-fill successions. Not abundant. Channel abandonment.	Pervasive clay- and silt-sized phyto-detrital, carbonaceous matter. Fining-upward successions are dominant. Gradational lower contact with carbonaceous-rich siltstone (Facies 2G) or carbonaceous-rich sandstone (2F). Infrequent root traces, a few cm long.	Fluvial Channel; Tidal-Fluvial Channel; Estuarine-Tidal Channel
2I - Mudstone-Clast Pebble Breccia	Matrix-supported breccia. Overall the entire facies is poorly sorted. > 30 %, > 2 mm A-SA carbonaceous-rich mudstone clasts. Mostly pebble-sized, but some granule- and cobble-sized mudstone clasts. Matrix is moderately sorted fL-cU sandstone.	Massive. No visible structures.	Infrequent *Planolites*, *Chondrites*, and *Schaubcylindrichnus*. BI: 0-2	Facies occurs within the channels. Both single- and multi-story. Highest concentrations near the base of the channel-fill successions. Basal lag deposits for single- and multi-story channel-fills, and also at contacts between adjacent channel-fills successions within the multi-story bodies. Sparse facies.	Mudstone clasts are carbonaceous-rich mudstone (Facies 2H) and siltstone (2G). Beds are 5-30 cm thick. Sharp and erosive lower bed contacts, gradational upper contacts. Some fining-upward successions. Grade upwards into carbonaceous-rich sandstone (Facies 2F), cross bedded sandstone (2A), and/or convolute bedded sandstone (2B). A-SA, elongated, sand-to-pebble sized coal clasts, finely disseminated plant material, and wood fragments are dispersed throughout this facies.	Fluvial Channel; Tidal-Fluvial Channel; Estuarine-Tidal Channel
2J – Fossiliferous, Fe-Cemented Sandy Breccia ("Coquina")*	Matrix-supported, sandy breccia. Poorly to moderately sorted. Sand-to-pebble-sized shells. Whole and broken shell fragments. Comprise 15-40 % of this facies. Sand to pebble-sized, SA-R, mudstone and siltstone clasts are common. Matrix is moderately well	Some current ripples and trough cross beds. Mostly massive.	Rare *Skolithos*. BI: 0-1	Lateral accretion sets. Predominantly a flat/non-erosive base. Localized incision is observed.	Whole and broken shell debris are bivalves and gastropods. Cream-coloured mudstone and siltstone clasts have little carbonaceous matter. Facies 2J is sparse. Only occurs at a few localities in the uppermost and distal parts of the Castlegate Sandstone in Salt Wash Canyon.	Tidal-Fluvial Channel; Estuarine-Tidal Channel; Washover Fan; Flood Tidal Delta

	sorted vfU-mL sandstone.					
3 –Coastal Plain Facies (non-channelized)	*Grain Size; Sorting*	*Sedimentary Structures*	*Trace Fossils; BI*	*Sedimentary Architecture*	*Other Characteristics*	*Interpretation*
3A - Current Rippled Sandstone	vfL-fL sandstone. Moderately well to well sorted. Some fining-upward grain size trends. Beds 2-10 cm thick. Sharp lower contact and gradational upper contact.	Current ripples.	Rare *Skolithos*. BI: 0-1	Sheet-like geometry. Tapers in all directions. Beds are not laterally extensive. Extend a few tens of meters. Moderately rare facies.	Some mudstone and coal clasts, sand-to-granule-sized and SA-SR. Rare wood fragments. Finely disseminated carbonaceous matter is dispersed throughout the facies. Isolated roots (rhizoliths). Fe-rich cements occur in patches. Generally this facies is tightly cemented. Interbedded with carbonaceous-rich siltstone (Facies 3C) and mudstone (3D).	Crevasse Splay; Wash-Over Fan; Flood Tidal Delta
3B - Carbonaceous-Rich Sandstone	Varying amounts of vfL-mU sandstone, with lesser amounts (i.e. 5-20 %) carbonaceous-rich silt and clay laminae. Beds are 1-20 cm thick. Moderately to poorly sorted.	Rare normally graded and convolute bedding. Nodules-concretions. Shrinkage cracks.	A number of unknown traces. Minor *Planolites*. BI: 1-5	Sheet- or patch-like geometry. Discontinuous.	Abundant finely comminuted plant matter. Numerous sand-to-pebble-sized, A-SA coal clasts. Some mudstone clasts. Sulfur-stained in places. Several roots (rhizoliths). A few mm's to a few cm's long. Concentrated along specific horizons. Fe-rich concretionary cements or nodules. Some densely fractured. Diffuse bed boundaries, both vertically and laterally. Transitions into carbonaceous-rich siltstone (Facies 3C) and mudstone (3D). Rare synaeresis cracks.	Floodplain; Overbank; Lagoonal; Paleosol
3C - Carbonaceous-	Intermixed silt, sand and clay. Predominantly medium-to-	Convolute bedded in places.	Numerous unknown traces, and	Sheet-like geometry with variable thickness.	Abundant finely disseminated plant material. Lesser amounts of coal and	Floodplain; Overbank;

Rich Siltstone	coarse grained silt. Sand is vfL-mU, and is scattered throughout, occasionally concentrated as laminae and/or thin beds. Sand is 5-30 %. Dark grey colour.	Nodules-concretions. Shrinkage cracks.	*Planolites*. Subordinate *Chondrites*, *Skolithos*, *Palaeophycus*, and *Teichichnus*. BI: 2-5	Cut by channel-fill facies.	mudstone clasts: sand-to-granule-sized, SA-SR. Some roots (rhizoliths). Overall mottled-stirred texture. Swirled. Concretionary texture. Tightly cemented layers. Some nodular-concretionary beds. White to red-brown. Calcite, dolomite, ankerite and siderite. Some fractures. White-colour on weathered outcrop face. Fe-rich in places. Interbedded with carbonaceous-rich mudstone (Facies 3D) and shale (3E). Gradational lateral and vertical facies contacts.	Lagoonal; Paleosol
3D - Carbonaceous-Rich Mudstone	Mostly dark grey-black, carbonaceous-rich mudstone. Also light grey and light green in scattered localities. Inter-mixed to inter-laminated vfL-fU sand and coarse silt. Rarely comprises > 10 % of this facies. Moderately well sorted.	Massive.	Dominantly *Planolites*, and unknown traces. Scarce *Chondrites*. BI: 2-5	Sheet- or patch-like geometries, dissected by channel-fill deposits.	Abundant phyto-detritals and sand-sized coal fragments. A few roots (rhizoliths), mm-width and up to 4 cm long. Mottled texture. Fe-rich in places. Interbedded with carbonaceous-rich siltstone (Facies 3C), sandstone (3B), and shale (3E). Lateral continuity is difficult to determine in outcrop due to vegetation and scree cover.	Floodplain; Overbank; Lagoonal; Paleosol
3E - Carbonaceous Shale	Dark black mudstone. Trace amounts of vfL-vfU sand and coarse silt.	Massive. No discernible vertical grain size trend.	Occasional *Planolites*, and unknown traces. BI: 0-2	Sheet-to-patch-like geometry.	Disseminated phyto-detritals and SA-SR, sand-to-pebble-sized coal clasts. Roots are common. Predominantly interbedded with coal (Facies 3F) and carbonaceous-rich mudstone (3D). Gradational vertical contacts with coal beds. Scattered pyrite (very finely- to medium-crystalline) and rare free sulphur (i.e.	Margins of Coastal Mire; Floodplain; Overbank

					yellow (patches).	
3F - Coal	Dark black. Shiny/reflective. Bituminous.	Cleated.	No trace fossils. BI: 0.	Locally-to-regionally continuous. Many coals are laterally continuous for hundreds of meters. Greatest lateral extent for are those that correlate with marine flooding surfaces (i.e. parasequence boundaries). Up to 8 km up-to-down-depositional-dip for the Top Cycle D11 (Top Desert Member) upper coal zone.	Coal beds are 5-35 cm thick. Individual coal seams split and merge. Interbedded with carbonaceous-rich shale (Facies 3E). Sulphur-rich patches throughout. Rare finely-disseminated, finely crystalline pyrite. Abundant roots (rhizoliths).	Coastal Mire

Table DR1. Facies descriptions and interpretations. Eight shallow marine facies (1A to 1H), ten channel facies (2A to 2J), and six coastal plain facies (3A to 3F) identified throughout the Desert Member to Lower Castlegate Sandstone stratigraphic interval.

Table DR2. Paleocurrent data from Lower Castlegate Sandstone channels (i.e. vector mean, number)

Location:	**van de Graaff (1972)** [2]	**Lawton (1986)** [3]	**Chan and Pfaff (1991)** [1, 4]	**Franczyk and Pitman (1991)**	**Miall (1993, 1994)** [5]	**Olsen et al. (1995)** [1]	**Van Wagoner (1995)** [1, 6]	**Robinson and Slingerland (1998)**	**Horton et al. (2004)** [7]	**Adams and Bhattacharya (2005)** [1]	**McLaurin and Steel (2007)** [8]	**Hoffmeister (2011)**	**Cross (2016)**	**Vector Mean and Number** [9]
NW of Book Cliffs									130° / 297					**130° / 297**
Chicken Creek								149° / 4						**149° / 4**
Red Narrows	183° / 40													**183° / 40**
Sweat Creek	112° / 40													**112° / 40**
Diamond Fork	41° / 43													**41° / 43**
Salina Creek-Canyon	282° / 32			125° / 25										**213° / 57**
Rock Canyon										224° / 23				**224° / 23**
Skutumpah	5° / 33													**5° / 33**
Link Canyon	72° / 34													**72° / 34**
Ferron Canyon	84° / 29													**84° / 29**
Sixmile Canyon								117° / 9						**117° / 9**
Joe's Valley	112° / 31	130° / 51	95° / 40					128° / 30					124° / 17	**117° / 169**
Star Point	104° / 30													**104° / 30**
Bear Creek								117° / 20						**117° / 20**
Bennion Creek	312° / 30							122° / 25						**226° / 55**
Price Canyon	60° / 30	87° / 21	112° / 143		113° / 8	108° / 42		103° / 54			131° / 51		131° / 11	**108° / 360**
Willow Creek	30° / 30				78° / 26									**52° / 56**
Soldier Creek	40° / 35				27° / 26			123° / 47						**73° / 108**
Whitmore Canyon	110° / 29													**110° / 29**
Sunnyside					106° / 51			118° / 30						**110° / 81**
Horse Cyn-North	82° / 29	118° / 114	79° / 91											**98° / 234**
Green River	109° / 29	111° / 32	125° / 92											**119° / 153**
Tusher Cyn-Wash	87° / 30	135° / 54			88° / 71		147° / 48	109° / 41				168° / 48		**122° / 292**
Coal Canyon												151° / 35		**151° / 35**
Stub Canyon												152° / 39		**152° / 39**
Horse Cyn-South												171° / 39		**171° / 39**
Hatch Mesa												182° / 6		**182° / 6**
Floy Wash					123° / 81									**123° / 81**
Floy Canyon												194° / 35		**194° / 35**
Crescent Canyon					103° / 34		107° / 2							**103° / 36**
Blaze Canyon	76° / 34											160° / 33		**117° / 67**
Thompson Wash	38° / 35													**38° / 35**
Thompson Canyon	88° / 31				223° / 31			95° / 6				153° / 42		**151° / 110**
Jeep Trail												174° / 29		**174° / 29**
Sagers Canyon					182° / 6		61° / 43					201° / 12		**100° / 61**
Vista Siding - BR	66° / 29													**66° / 29**
Nash Wash - DF	240° / 23													**240° / 23**
Bull Canyon							148° / 14					293° / 9		**205° / 23**
Calf Canyon							97° / 7							**97° / 7**
Strychnine Wash							235° / 20					170° / 12		**211° / 32**
Horse Pastures							115° / 22					220° / 35		**179° / 57**
Big Hole Wash							142° / 8							**142° / 8**
Sulphur Cyn - DF	202° / 27													**202° / 27**
Westwater Cyn - DF	258° / 28													**258° / 28**
San Arroyo - DF	263° / 16													**263° / 16**
[9] Mean / Total # =	**116°/777**	**120°/272**	**105°/366**	**125°/25**	**110°/334**	**108°/42**	**128°/164**	**116°/266**	**130°/297**	**224°/23**	**131°/51**	**175°/374**	**127°/28**	**125° n = 3,019**

Note: Previous studies are shown in chronological order along the top. Locations are organized at left from west to east.

[1] Vector means were measured from the arrow plotted on each rose diagram (i.e. angle in degrees was not given). [2] van de Graaff (1972) paleocurrent data includes "Beach Ridges" (BR), "Delta Front" (DF). [3] Lawton's (1986) paleocurrent rose diagrams are included, in whole or in part, by others (egs. Franczyk and Pitman 1991; Willis 2000; Miall and Arush 2001a,b). [4] Chan and Pfaff (1991) do not show the total number of measurements (n) per rose diagram. These were estimated from each diagram. Multiple roses were merged together as weighted mean data sets. [5] Miall's (1994) paleocurrent data is a smaller sub set of the Miall (1993) data. Calculated and used a weighted mean for Tusher Canyon (A, B), Floy Wash (A, B), and Thompson Canyon (A, B). [6] Van Wagoner (1995) compilation paleocurrent rose diagram shows n=188 (Figure 48, page 202). Total of individual roses shown is lower (n=164) (Figure 48, page 202). Strychnine Wash data set is bi-modal and shown by Van Wagoner (1995) as two separate rose diagrams. These averaged into one data set (see comments below). [7] Horton et al. (2004) paleocurrent data from both the Lower and Upper Castlegate Sandstone, and Price River Formation. Collected from 29 stations northwest of the Book Cliffs in the Charleston-Nebo salient region. [8] McLaurin and Steel (2007) did not plot vector means. An average of the thalweg-fill-units (152°) and bar-units (110°) provided a value of 131°. [9] Mean azimuth is the basic/numerical average only. All of the original data would be needed to properly calculate the mean. Therefore, the calculated mean is a "*best estimate*" only, given these data constraints. See text for further discussion.