GEOLOGICAL SURVEY OF CANADA
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Description of some cores from Cambrian and Lower Ordovician strata of Saskatchewan

J. Dixon

2008

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INTRODUCTION

This report contains descriptions of core in Cambrian to Lower Ordovician strata from 24 wells in the subsurface of Saskatchewan (Figure 1). The cores include strata from the Basal Sandstone Unit, and the Earlie, Deadwood, and Winnipeg formations, although only two contain the latter formation. The stratigraphic nomenclature is that used by Dixon (Figure 2; 2007)

The descriptions start from the top of the core and proceed down. This is not a normal stratigraphic procedure, most stratigraphic sections are described from bottom (oldest) to top (youngest). However, the top of the core is the least likely part to have lost material; consequently it is a better fixed depth than starting at the bottom, where core may have been lost. Measurements are based on the reported depths, i.e., measured from the top of the core. The well name and location usually were taken directly from the core boxes, however, the operator may have changed over time and the amount of reported recovered core may not correspond with what was measured.

A number of cores are described only briefly, this commonly reflects the poor quality of the core or similar facies throughout the core.

The descriptions of the cores are arranged first by separating the wells based on their presence within the W2 or W3 meridians (Table 1: Summary of Core Descriptions). Within the meridians the wells are arranged first by township, then range and finally by lsd.

TABLE 1: SUMMARY OF CORE DESCRIPTIONS

West 2

Well Location	Core #	Top Depth m(ft)	Bottom Depth m(ft)
16-23-2-1W2	1	2775	2804.7
15-5-46-9W2	6	762 (2500)	771.8 (2532)
1-15-48-17W2	5	688.2 (2258)	697.4 (2288)
12-15-52-14W2	1	451.1 (1480)	460.2 (1510)

West 3

10-3-5-8W3	1	2550.6 (8368)	2571.9 (8438)
9-32-6-22W3	1	2671 (8763)	2698.4 (8553)
5-7-14-10W3	170 to 202	2094 (6860)	2164.1 (7100)
2/5-7-14-10W3	1	2164.1 (7100)	2171.4 (7124)
	2	2171.4 (7124)	2174.4 (7134)
11-3-17-14W3	1 to 4	2008.6 (6590)	2061.4 (6763)
	5 to 7	2067.8 (6784)	2078.7 (6820)
1-9-17-14W3	4	2004.1 (6575)	2025.4 (6645)
7-9-17-14W3	1	1973.6 (6475)	1985.2 (6513)
3-10-17-14W3	1	1976 (6483)	2054.4 (6740)
15-34-34-27W3	1	2013.8	2032
4-5-35-26W3	3	2032	2050.4

3-18-36-25W3	1	1977	1995.3
16-36-36-25W3	3	1934	1943
4-28-38-24W3	11 and 12	1585 (5200)	1542.6 (5225)
	13	1641 (5384)	1648.7 (5409)
	14	1696.2 (5565)	1703.8 (5590)
	15	1770.3 (5808)	1777.9 (5833)
	16	1834.3 (6018)	1841.9 (6043)
	17	1887.3 (6192)	1898 (6227)
	18	1952.2 (6405)	1953.8 (6410)
3-4-39-13W3	12	1543.8 (5065)	1553 (5095)
	13	1635.3 (5365)	1642.9 (5390)
	25	1744.7 (5724)	1753.8 (3806)
8-3-40-14W3	12	1521 (4990)	1528.6 (5015)
	13	1585.9 (5203)	1588 (5210)
	14	1672.2 (5488)	1680.4 (5513)
12-30-49-27W3	4 and 5	1634	1649.3
	6	1652	1666
7-14-56-17W3	6 and 7	890 (2920)	900 (2952)
	9	976.6 (3204)	977.2 (3706)
	10	1044.9 (3428)	1049.7 (3444)
	11	1154.3 (3787)	1160.1 (3806)
13-21-61-15W3	5 to 16	697.7 (2289)	716 (2349)
	17 and 18	730 (2394)	742.8 2437)
8-8-64-2W3	1 and 2	580.9 (1906)	592.8 (1945)
	3	601.1 (1972)	605.6 (1987)
13-18-65-11W3	1	597.7 (1961)	613 (2011)

REFERENCES

Dixon. J. 2007. Correlations in Cambrian and Lower Ordovician strata of Saskatchewan. Geological Survey of Canada, Open File 5523, 18 p. [CD-ROM]

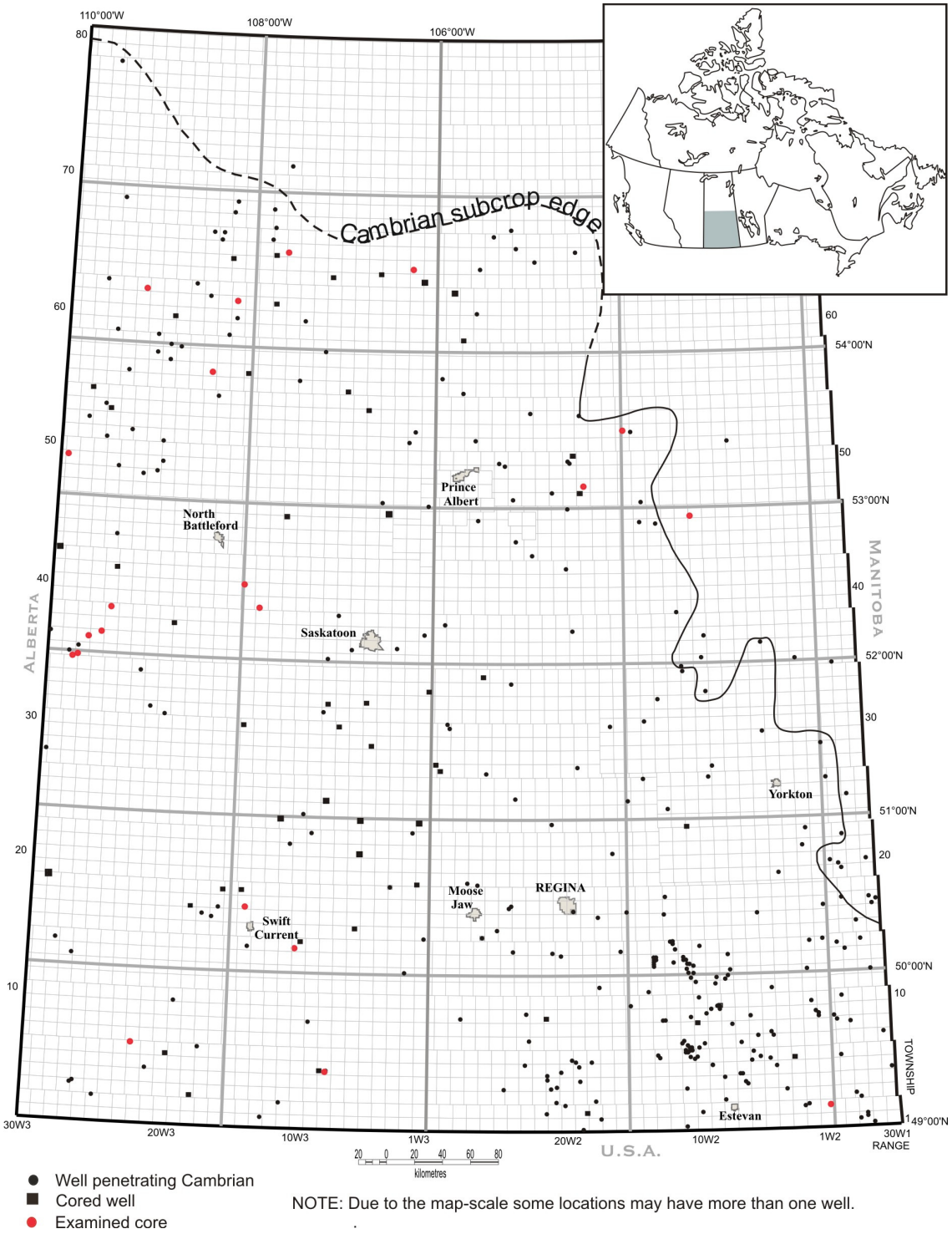


Figure 1. Location map of cored wells described in this open file.

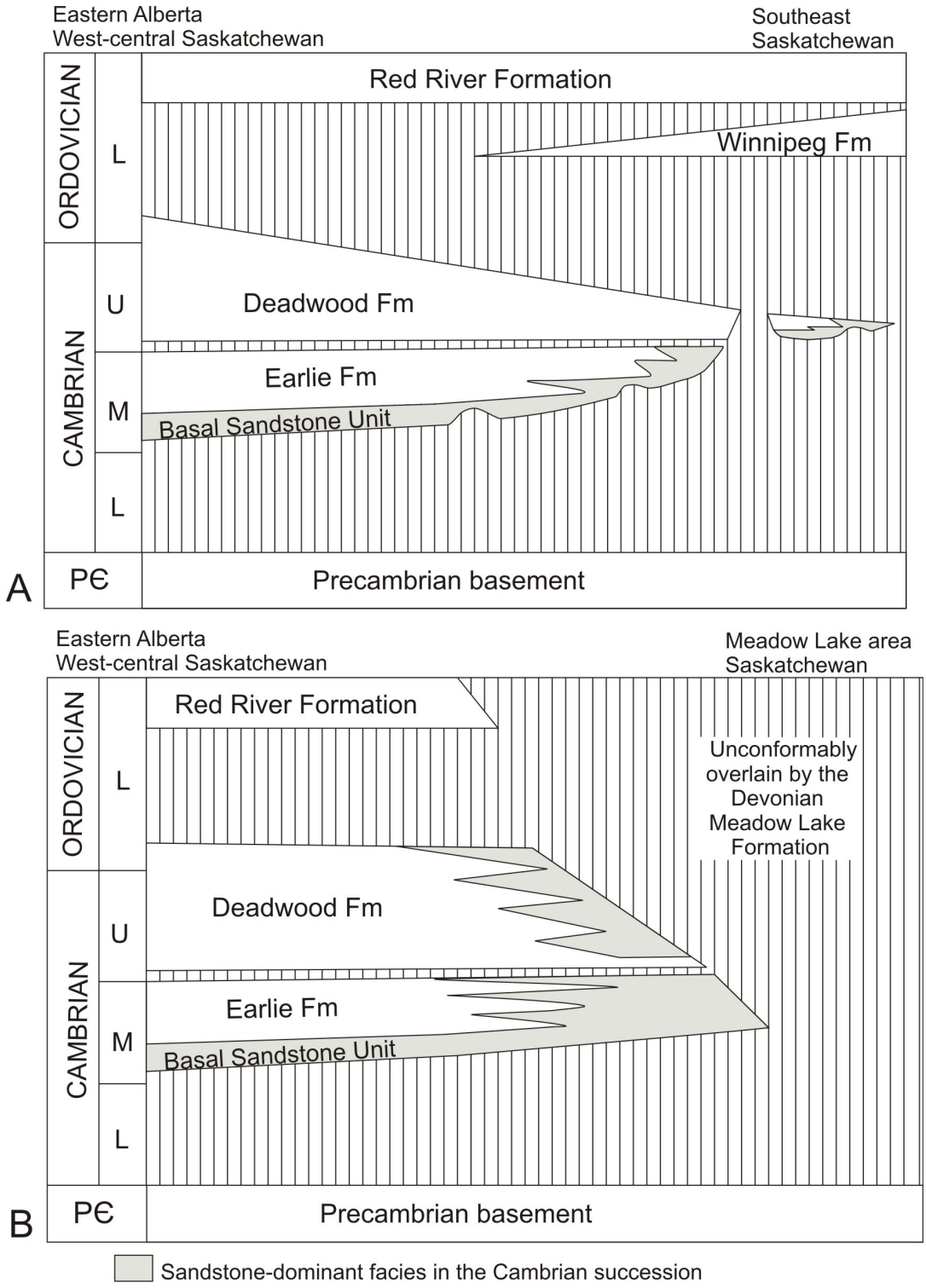


Figure 2. Stratigraphic nomenclature (modified from Dixon, 2007).

DESCRIPTION OF CORES

WEST 2

Husky Glen Ewen 16-23-2-1W2

Core 3: 2775 – 2793 m. 14 boxes.
Core 4: 2793 – 2804.2 m. 8 boxes.
Full diameter. Well preserved.
Examined 11th October 2007.

DEADWOOD FM

2775 – 2775.54 m	Interbedded sandstone-mudstone: Thoroughly bioturbated – mostly horizontal burrows. Possibly some bed deformation. Gradational basal contact.
2775.54 – 2776.48 m	Sandstone: Very fine to fine grained. A thick basal bed (about 20 inches thick) containing low angle intersecting laminae. Most of interval consists of thin sandstone beds separated by mm-thick mudstone layers.
2776.48 – 2777.40 m	Sandstone: Argillaceous, very fine to fine grained. Burrow mottled. Slight greenish hue (probably due to clay type). Contains two thin non-burrowed sandstone beds near base.
2777.40 – 2778.44 m	Sandstone: Fine grained. Well bedded. Beds separated by clay-rich sands or burrowed argillaceous sandstone.
2778.44 – 2779.75 m	Sandstone: Burrow mottled. Cf. interval 2776.48-2777.4 m. Abrupt basal contact (Figure 3a).
2779.75 – 2780.03 m	Sandstone: thin beds of finely laminated fine grained sandstone with two thin (0.5 cm) mudstone beds.
2780.03 – 2780.42 m	Sandstone: burrow mottled.
2780.42 – 2780.71 m	Sandstone: Well bedded. Cf. interval 2777.4-2778.44 m.
2780.71 – 2781.13 m	Sandstone: burrow mottled. Cf. interval 2776.48-2777.4 m.
2781.13 – 2781.23 m	Sandstone: Very fine to fine grained. Four alternating beds of laminated and burrowed sandstone.
2781.23 – 2781.45 m	Interbedded sandstone mudstone: Very fine to fine grained sandstone beds a few mm to 3 cm thick separated by very thin mudstone layers.
2781.45 – 2781.58 m	Conglomerate: Rounded elongate sandstone clasts in a medium to coarse sand matrix (Figure 3b).

2781.58 – 2783.81 m Sandstone: Fine to medium grained. Greenish hue. Green ?chloritic clay laminae throughout. Quartz and black chert grains. Multiple beds of cross bedded or massive sandstone grading up into clay laminated sandstone or burrowed argillaceous sandstone (Figures 3c and 4a). Abrupt basal contact.

2783.81 – 2787.41 m Sandstone: fine to medium grained. Dirty white colour. A few cm below top of interval is a clay-rich burrowed zone and about 28 cm below top is a 5 mm mudstone bed. Difficult to see any internal structures due to milling on outer surface of core.

2787.41 – 2788.17 m Sandstone: interbedded burrowed and laminated sandstone beds varying from 2 to 6 cm thick. Fine grained (Figure 4b).

2788.17 – 2789.28 m Sandstone: Fine to medium grained. Porous. A few clay laminae. Internal scour surfaces suggest multiple beds. Traces of cross laminae. Abrupt basal contact.

2789.28 – 2789.39 m Conglomerate: rounded sandstone clasts in a sand matrix (Figure 5a). Basal contact irregular and abrupt.

2789.39 – 2791.80 m Sandstone: fine to medium grained, locally coarse. Greenish hue in a generally white sandstone. Green colour may be a mixture of glauconite (some green sands grains) and chloritic clay. Cross bedded throughout (Figure 5b). Abrupt basal contact (Figure 5c).

2791.80 – 2793 m Sandstone: burrow mottled. Abundant clay layers.

2793 – 2793.22 m Sandstone: Fine to medium grained. Cross bedded. ?Glauconitic. Abrupt basal contact.

2793.22 – 2793.52 m Interbedded mudstone-sandstone: green coloured burrowed mudstone alternating with beds of burrowed sandstone.

2793.52 – 2793.95 m Sandstone: medium to coarse grained. Cross bedded. Contains mm-size mud clasts along some of cross beds (Figure 6a).

2793.95 – 2794.02 m Sandstone: Burrow mottled, greenish white (bottom of core 3).

2794.02 – 2794.18 m Sandstone: Fine to medium grained. Greenish hue, but less than overlying sandstone.

2794.18 – 2794.26 m Sandstone: burrow mottled.

2794.26 – 2794.51 m Sandstone: Medium grained. White. Small (mm-scale) mud clasts near base of interval. Internal structures not visible except for some coarse laminae in basal 2 cm. Abrupt basal contact.

2794.51 – 2795.11 m Sandstone: Burrow mottled. Clay content has yellowish green colour.

2795.11 – 2795.23 m Sandstone: White. Fine grained. Difficult to see internal structures due to milling on core surface.

2795.23 – 2795.42 m Sandstone: burrow mottled.

2795.42 – 2795.52 m Sandstone: Cf. 2795.11-2795.23 m.

2795.52 – 2795.99 m Sandstone: burrow mottled.

2795.99 – 2796.09 m Sandstone: Cf. 2795.11-2795.23 m.

2796.09 – 2796.24 m Sandstone: burrow mottled.

2796.24 – 2796.77 m Sandstone: White. Fine to medium grained. Abrupt basal contact. Internal structures not visible.

2796.77 – 2797.10 m Sandstone: burrow mottled.

2797.10 – 2798.36 m Sandstone: White. Fine to medium grained. Abrupt basal contact. Milling on outer core surface masks internal features.

2798.36 – 2798.45 m Sandstone: burrow mottled.

2798.46 – 2798.55 m Sandstone: Cf. 2797.10-2798.36 m.

2798.55 – 2798.63 m Sandstone: burrow mottled.

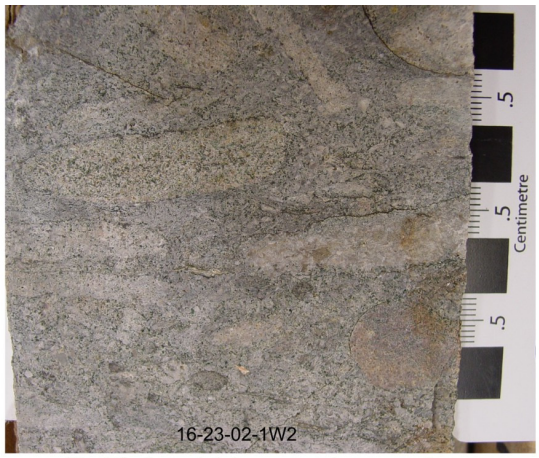
2798.63 – 2798.77 m Sandstone: Cf. 2797.10-1798.36 m.

2798.77 – 2799.28m Sandstone: burrow mottled. A few zones of remnant bedding. Abrupt basal contact (Figure 6b).

2799.28 – 2800.78 m Granite detritus: Coarse detritus of granite alternating with very thin to thick beds of dark greenish grey sandstone (Figures 7a, b, 8a to c). Contact with basement granite chosen where granite appears to be in situ and not weathered into clasts. However, below this depth there are clay-filled fractures and small cavities in the granite (Figure 8d).

2800.78 – 2804.2 m Granite: most of the lower part of core is missing.

A. Burrow-mottled sandstone-mudstone



B. Flat-pebble conglomerate
2781.45 - 2781.58 m

C. Cross bedded sandstone with mud laminae

Figure 3. Well 16-23-2-1W2

A. Basal bed contact (arrow) at 2783.1 m

B. Interbedded burrowed and cross bedded sandstone

Figure 4 Well 16-23-2-1W2

A. Conglomerate bed

B. Cross bedded coarse-grained to granular sandstone

C. Contact (arrow) between cross bedded and burrowed sandstone at 2791.8 m

Figure 5. Well 16-23-02-1W2

A. Cross bedded sandstone with mud clasts

B. Contact at 2799.28 m between granite-pebble conglomerate and sandstone

Figure 6. Well 16-23-2-1W2

Examples of basal sandstone with varying amounts of basement-derived detritus

Figure 7. Well 16-23-2-1W2

A. Well-sorted sandstone from the basal beds

B. Examples of basal sandstone with varying amounts of basement-derived detritus

C. Contact with basement granite at 2800.78 m

D. Granite basement with clay-filled fractures below 2800.78 m

Figure 8. Well 16-23-2-1W2

California Standard Bannock 15-5-46-9W2
Core 11: 2500 – 2520 ft. 4 boxes.
Core 12: 2520 – 2532 ft. 3 boxes.
Full diameter. Well preserved.
Examined 11th October 2007.

?WINNPEG FM

2500' – 2518' 1"	Sandstone: Fine grained. Burrow mottled. Brownish grey. Abrupt basal contact.
2518' 1" – 2519' 9"	Mudstone: medium grey. Massive.
2519' 9" – 2523' 11"	Sandstone: Very fine to fine grained. Burrow mottled. Basal few cm contains large, angular red-coloured mudstone clasts. Basal contact not preserved.
2523' 11" – 2527' 7"	Mudstone: Medium grey. Partially fissile.
2527' 7" – 2528' 7"	Sandstone: Fine grained. Argillaceous. Thoroughly bioturbated. Contact with underlying granite is a thin interval (few cm) of burrowed granite with mud filling the burrows (Figure 9).
2528' 7" – 2532'	Granite.

2527’ 7” - 2528’ 7”: burrowed sandstone immediately overlying granite basement

Figure 9. Well 15-5-46-9W2

California Standard Ratner 1-15-48-17W2

Core 16: 2258 – 2278 ft. 5 boxes. Full diameter. Mostly full diameter with a few slabbed pieces.

Examined 11th October 2007.

WINNIPEG FM

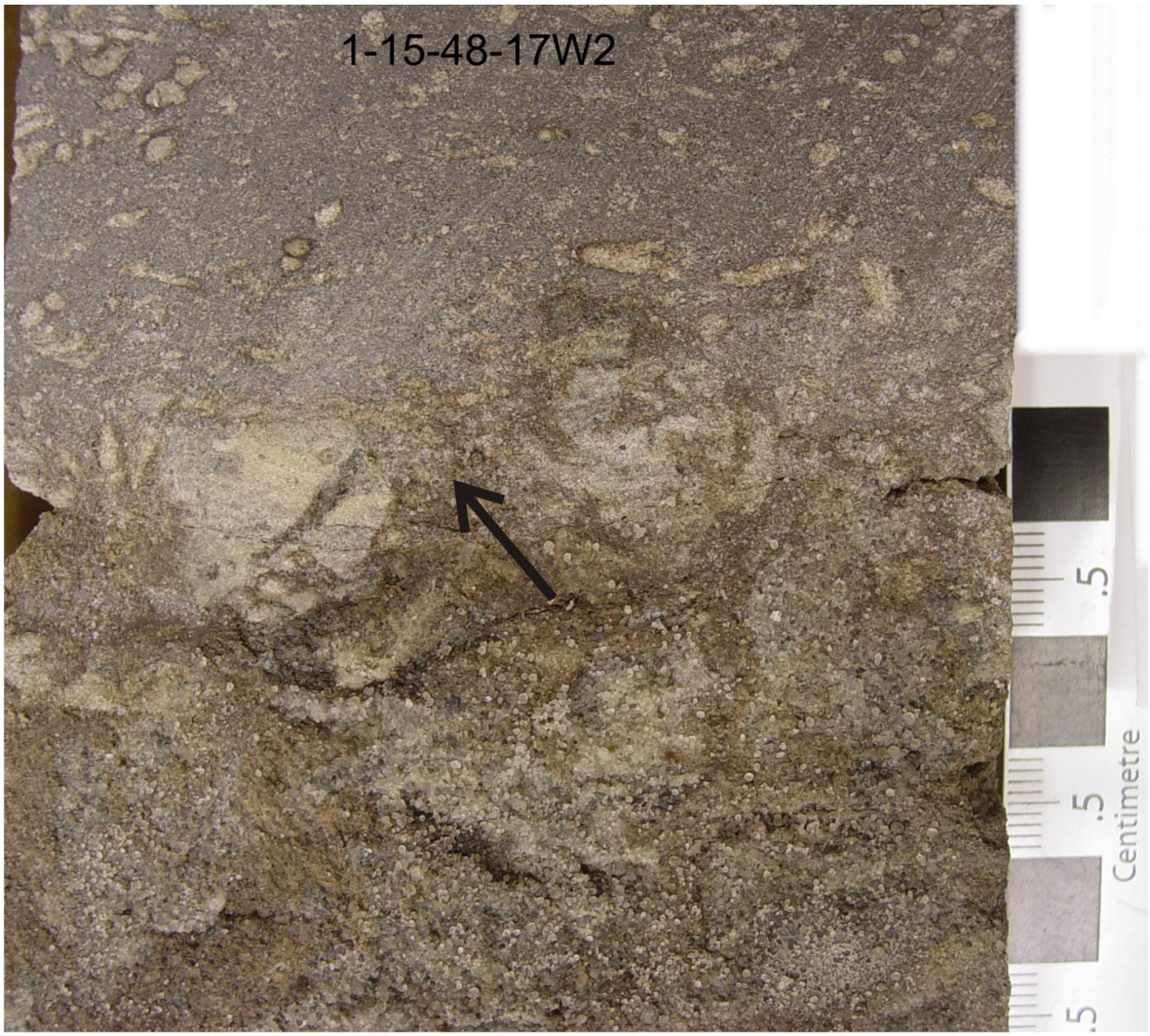
2258' – 2276' Sandstone: Fine grained – varies from argillaceous sandstone to a relatively "clean" sandstone. Burrow mottled. A few intervals of burrow mottled sandy mudstone. Abrupt basal contact.

Basal Sandstone Unit

2276' – 2278' Sandstone: Coarse grained. Cross bedded. Core broken into small pieces, consequently only about 1 ft. of the interval is preserved.

Winnipeg-Basal Sandstone Unit contact is preserved (Figure 10) and is fairly abrupt – a thin burrowed medium to coarse grained sandstone overlain by a burrowed sandy mudstone.

NOTE: log-core depths about the same for the contact.



Burrowed contact (arrow) between the Winnipeg Fm and Deadwood sandstone at 2276’

Figure 10. Well 1-15-48-17W2

Triad Whitefox 12-15-52-14W2
Core 1: 1480 – 1510 m. 1 box. Poorly preserved – broken into small pieces.
Examined 11th October 2007.

Depths indicate the core intersects the Winnipeg-Deadwood contact (log depth 1487 m) but actual contact does not appear to be preserved in the core.

Winnipeg Fm: basal zone of small clasts and very coarse sandstone grading up into a fine grained sandstone. Reddish brown colour.

Deadwood Fm: fine to medium grained sandstone, locally coarse. Dirty white colour with a greenish tint (due to clay matrix in parts of the sandstone).

WEST 3

Int. Helium WD Mountain 10-3-5-8W3

Core 1: 8368 – 8395 ft. 6 boxes. Full diameter. Moderately well preserved.
Examined 9th October 2007.

DEADWOOD FM

8368 – 8372 ‘	Interbedded mudstone-sandstone: Beds a few mm to 3 cm thick, most are 1 cm. Some ripple beds (lenticular beds). Mostly very finely laminated. Minor load deformation. Horizontal burrows are common; fewer vertical burrows. Very fine grained sandstone (Figures 11a, b, and c).
8372 – 8376’ 6”	Sandstone: predominantly very thin beds (<3 cm) sandstone beds separated by mud laminae or very thin (5 mm) mudstone beds. Some horizontal burrows.
8376’ 6” – 8374’ 6”	Interbedded sandstone-mudstone: approximately equal amounts of sandstone and mudstone. Beds generally <1 cm thick. Similar to overlying interval.
8374’ 6” – 8374’ 9”	Sandstone: very fine grained. Abrupt upper and lower contacts. Finely laminated.
8374’ 9” – 8375’	Mudstone/shale: medium grey. Partially fissile.
8375 – 8377’ 4”	Interbedded sandstone-mudstone: Predominantly sandstone. Similar to interval 8373’ 5” – 8374’ 6”.
8377’ 4” – 8377’ 11”	Mudstone/shale: Minor sandstone beds.
8377’ 11” – 8379’	Interbedded sandstone-mudstone: cf. other similar intervals.
8379’ – 8381’ 7”	Shale: greenish grey colour.
8381’ 7” – 8381’ 9”	Sandstone: medium to coarse grained. Light grey to white with slight greenish tint. Contacts not preserved (Figure 11d).
8381’ 9” – 8382’ 9”	Interbedded sandstone-shale: Overall fining-up trend. (i.e., shaling-up with shale dominant in top 5–6 ft.). Abrupt basal contact (Figure 12a).

?Basal Sandstone Unit or Earlie Fm

8382’ 9” – 8384’ 5”	Sandstone: medium to coarse grained. Slight brownish hue due to oxidation of iron-bearing minerals. Mostly quartz with some black chert. Basal contact not preserved.

8384’ 5” – 8384’ 9”	Interbedded sandstone-mudstone: Very thin sandstone beds (1 – 2 cm) separated by mud laminae (<5 mm).
8384’ 9” – 8385’ 1”	Sandstone: medium to coarse grained. Cf. 8382’ 9”– 8384’ 5”. Basal contact poorly preserved, appears to be abrupt.
8385’ 1” – 8385’ 8”	Interbedded mudstone sandstone: Cf. 8384’ 5” – 8384’ 9”.
8385’ 8” – 8387’ 8”	Mudstone/shale: a few very thin (<5 mm) sandstone beds.
8387’ 8” – 8389’ 6”	Interbedded sandstone-mudstone: predominantly sandstone. Abundant horizontal burrows (Figure 12b). Abrupt basal contact (Figure 12c).
8389’ 6” – 8390’ 2”	Sandstone: medium grained. Glauconitic. Pyrite commonly associated with concentrations of glauconite. Mostly well rounded quartz grains. (Figure 12c).
8390’ 2” – 8395’	Missing core.

A. Thin interbeds of laminated sandstone and burrowed mudstone.

B. Load-deformed sandstone bed

C. Thin interbeds of sandstone-mudstone with thicker bioturbated bed.

D. Isolated bed of coarse-grained sandstone

Figure 11. Well 10-3-5-8W3

A. Contact between Deadwood Fm and either the Earlie Fm or BSU

B. Thin interbeds of laminated and burrowed sandstone

C. Glauconitic, medium grained sandstone abruptly overlain by thinly interbedded to inter-laminated mudstone and sandstone

Figure 12 Well 10-3-5-8W3

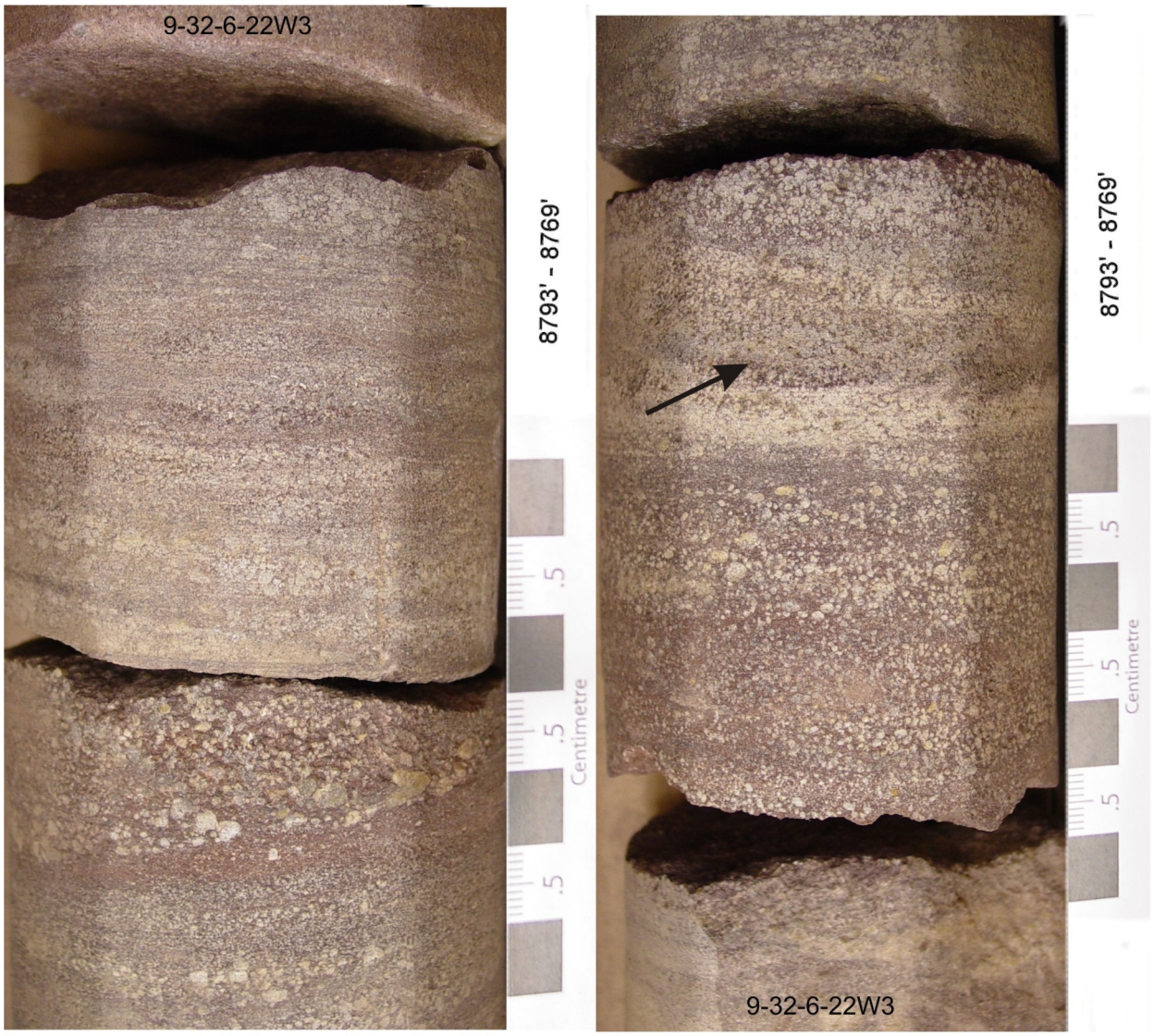
M.O.W.S. Knollys 9-32-6-22W3

Core 1: 8763 - 8769 ft. 2 boxes. Mostly full diameter but some pieces are broken along the vertical axis of the core. Moderately well preserved.

Examined 9th October 2007.

?Basal Sandstone Unit or a local basal sandstone of the Deadwood Fm.

Sandstone: Arkosic. Variable colour, ranging from brownish grey to reddish grey. Medium to coarse grained interspersed with layers of granular sandstone. Large granules are mostly glass-like quartz. Subhorizontal bedding with some ripple beds (Figure 13).



A. Cross beds in arkosic sandstone

B. Large-ripple cross-laminae (arrow) in arkosic sandstone

Figure 13. Well 9-32-6-22W3

T.W. Braddock Creek 5-7-14-10W3

Cores 170 - 174: 6860 – 6896 ft. Boxes 163 – 166.
175 - 178: 6896 – 6955 ft. Boxes 167 – 170.
181 - 187: 6955 – 6999 ft. Boxes 171 – 174.
187 - 191: 6999 – 7028 ft. Boxes 175 – 178.
192 – 196: 7028 – 7060 ft. Boxes 179 – 182.
197 - 200: 7053 – 7085 ft. Boxes 183 – 186.
200 – 202: 7085 – 7100 ft. Boxes 187 – 188.

Small diameter core (2"). Fairly well preserved but core broken into short segments.
Examined 9th October 2007.

DEADWOOD OR EARLIE FM

6860 – 6869' 3" Limestone: medium brownish grey. Microcrystalline. Scattered vugs. Basal contact not preserved.

6869' 3" – 6869' 5" Sandstone: fine grained. Black chert and clear/white quartz. Basal 10 cm contains large sub-angular clasts of limestone and/or mudstone up to 4 cm long. Abrupt basal contact (Figure 14a).

6869' 5" – 6882' 2" Limestone: brownish grey. Microcrystalline. Vaguely bedded. Transitional basal contact.

6882' 2" – 6912' 7" Mudstone: brick-red to maroon colours. Interbedded with very thin to thin beds of carbonate a few mm to a few cm thick. Abundant soft sediment deformation – such as over-steepened bedding. Basal contact not preserved.

6912' 7" – 6915' 7" Limestone/argillaceous limestone: reddish tint. Microcrystalline. Basal contact not preserved.

6915' 7" – 6920' 11" Mudstone: similar to above.

6920' 11" – 6921' Limestone: creamy white. Microcrystalline. Horizontal fractures filled with coarse crystals (Figure 14c).

6921 – 6932' 10" Mudstone: similar to above but with thicker carbonate interbeds. Basal contact is over-steepened.

6932' 10" – 6963' 6" Interbedded limestone-red mudstone: Limestone beds are thicker than those in overlying intervals. Red tinted carbonate beds. Bed deformation is common, commonly seen as over-steepened bed contacts (Figure 14d). Transitional basal contact.

6963' 6" – 7060' Interbedded mudstone-limestone: beds are a few mm to few cm thick.

Less deformation than overlying interval (Figure 14e).

NOTE: core depths on boxes indicate there is overlap of cores 196 to 197 consequently core descriptions follow the given depths on the boxes.

7053' – 7056'	Interbedded limy mudstone and fine grained sandstone: Beds a few mm to about 2 cm thick. Slight reddish tinge. Bedding inclined to about 20 degrees. Transitional basal contact.
7056 '- 7100'	Arkosic sandstone: Brick red to dark maroon colours. Fine to medium grained. Multiple beds. Some intervals of laminae and very thin beds (mm-scale) of mudstone (Figure 14f).

A. Large clasts at base of bed

B. Coloration cross-cutting beds

C. Light grey limestone in a predominantly sandstone succession

D. Over-steepened bedding

E

F. Arkosic sandstone Over-steepened bedding

D and E. Interbedded limestone-mudstone-sandstone

Figure 14. Well 5-7-14-10W3

Helium Corp. McWatters 2/5-7-14-10W3
Core 1: 7100 – 7124 ft. 5 boxes. Full diameter. Well preserved. 3.5" core.
Core 2: 7124 – 7136 ft. 2 boxes. Full diameter. Well preserved. 3.5" core.
Highly inclined bedding about 60 degrees.
Measurements made along vertical axis of core, no compensation for dip.
Examined 9th October 2007.

DEADWOOD OR EARLIE FM

7100 – 7100' 5" Arkosic sandstone: fine to medium grained. Maroon coloured.

7100' 5" – 7101' 2" Interbedded sandy mudstone and ?limestone/dolostone: red/maroon mudstone and cream-coloured carbonate. Carbonate beds have abrupt contacts. Beds a few mm to few cm thick. Some bed deformation (Figure 15a).

7101' 2" – 7101' 10" Interbedded sandstone-mudstone, minor carbonate: Red/maroon colours. Similar to above but without much carbonate and beds tend to be slightly thicker. Some deformation.

7101'10" – 7102' 9" Arkosic sandstone: Minor red mud laminae. Bedded (appears to be horizontal). A limestone clast near base of interval (could be a disrupted carbonate bed?).

7102' 9" – 7102' 10" Limestone/mudstone: highly disrupted bedding.

7102' 10" – 7108' 2" Arkosic sandstone: fine to medium grained. Massive. Maroon coloured. Some (?)carbonate clasts about 7–9 ft. above base. Base chosen at a very thin mudstone layer overlying a well bedded sandstone.

7108' 2" – 7110' 1" Arkosic sandstone: mostly fine grained. Maroon coloured. Well bedded (Figure 15b). Abrupt basal contact.

7110' 1" – 7113' 11" Interbedded sandstone-mudstone-limestone: cf. interval 7100' 5"-7101' 2" but with sandstone. Maroon coloured. One thick bed is severely deformed (Figure 15c) into a ball structure. Abrupt basal contact (Figure 16a).

7113' 11" – 7124' Arkosic sandstone: maroon coloured. Fine to medium grained. Massive. Top 1.5 ins contains mm-scale mud laminae (Figure 16b).

A. Over-steepened beds of mudstone and ?limestone

B. Over-steepened beds of arkosic sandstone

C. Sand ball

Figure 15. Well 2/5-7-14-10W3

A. Contact between interbedded sandstone-limestone and arkosic sandstone at 7113' 11" (arrow). Over-steepened bedding

B. Arkosic sandstone

Figure 16. Well 2/5-7-14-10W3

Gulf Wilhelm 11-3-17-14W3

***Cores 1 to 4*:** 6590 - 6637 ft. 9 boxes.
6637 - 6697 ft. 13 boxes.
6697 - 6746 ft. 10 boxes.
6746 - 6763 ft. 4 boxes.

2" diameter core. Full diameter with some slabbed pieces. Generally well preserved.
Examined 10th October 2007.

DEADWOOD FM

6590 - 6636' 3"	Shale/Mudstone: Medium to dark grey. Fine silt laminae throughout. Thin subhorizontal fractures filled with a rusty weathering material (calcite or dolomite?) (Figure 17a).
6636' 3" - 6641 ft	Interbedded shale-sandstone: very thin to thin beds of very fine grained sandstone interbedded with very thin to thick beds of shale. Sandstone beds are a few mm to 7 cm thick, but most are <2 cm. Lenticular sand beds common. Small vertical and horizontal burrows present but not common (Figure 17b). Contains subhorizontal fractures similar to overlying unit.
6641 - 6644' 3"	Shale/Mudstone: as above.
6644' 3" - 6655' 3"	Interbedded sandstone-mudstone: Thin to thick beds of very fine to fine grained sandstone interbedded with thin mudstone beds. Predominantly sandstone in interval. Finely laminated sandstone (Figure 17c) - some current ripple laminated. Scattered occurrences of horizontal burrows - usually associated with muddy layers (Figures 17d and 18a). Lowest sandstone unit rests abruptly on underlying beds.
6655' 3" - 6660' 8"	Mudstone/Shale: Minor sand lenses (ripple laminae) to very thin beds. Burrows associated with one of the sandy beds.
6660' 8" - 6661' 4"	Sandstone-Mudstone: Thin to thick beds of sandstone separated by mudstone layers a few cm thick.
6661' 4" - 6662' 6"	Mudstone/Shale: similar to above.
6662' 6" – 6663' 8"	Sandstone-Mudstone: predominantly sandstone. Sandstone beds a few mm to 4 cm thick, separated by very thin silty/sandy mudstone layers that are generally <1 cm thick. Small horizontal burrows are common in the mudstone layers. Ripple laminae common in sandstone beds (Figure 18b).
6663' 8" – 6674'	Mudstone/shale: A few thin sandstone beds near top of interval. Cf. other mudstone intervals.

6674’ – 6675’ 1” Muddy sandstone beds: Abrupt basal contact; transitional upper contact. Difficult to detect internal structures.

6675’ 1” – 6675’ 11” Mudstone/shale: A thin sandstone bed near top of interval.

6675’11” – 6680’ 5” Interbedded mudstone-sandstone: Predominantly mudstone. Very thin to thin (mm to 5 cm) beds of very fine grained sandstone separated by generally thicker (mm to 12 cm) mudstone beds. Minor occurrences of horizontal burrows (Figure 18c).

6680’ 5” – 6697’ 6” Mudstone: contains at least one sandstone interbed near bottom of core 2 and near base of interval.

6697’ 6” – 6698’ 2” Interbedded sandstone-mudstone: Mostly sandstone. A few burrows. Similar to other sandstone-mudstone intervals.

6698’ 2” – 6702’ 4” Mudstone: a few scattered sandstone beds.

6702’ 4” – 6703’ 2” Interbedded sandstone-mudstone: tendency for sandstone content to increase up-section. Similar to other sandstone-mudstone intervals.

6703’ 2” – 6711’ 7” Mudstone/shale: Scattered to locally concentrated very thin to thin beds of sandstone.

6711’ 7” – 6712’ 5” Interbedded sandstone-mudstone: About equal amounts of sandstone and mudstone. Similar to other sandstone-mudstone intervals.

6712’ 5” – 6717’ 7” Mudstone/shale: A few scattered very thin beds of sandstone.

6117’ 7” – 6718’ 7” Sandstone: very fine to fine grained. Abrupt basal contact; transitional upper contact. Slightly load deformed basal contact. Internal structures not apparent.

6718’ 7” – 6720’ 10” Mudstone/shale: a few scattered sandstone beds.

6720’ 10” – 6721’ 2” Sandstone: beds of very fine grained sandstone separated by clay layers a few mm thick.

6721’ 2” – 6726’ 8” Mudstone/shale: cf. similar intervals. A few thin sandstone beds.

6726’ 8” – 6727’ 2” Sandstone: abrupt basal contact; transitional upper. Internal structures not apparent.

6727’ 2” – 6730’ 9” Mudstone/shale: cf. other similar intervals. A few sandstone beds.

6730’ 9” – 6734’ Interbedded sandstone-mudstone: Varies from silt/sand laminae to 5 cm thick beds of very fine grained sandstone (Figure 19a). Interval contains examples of sand balls (Figure 18d).

6734 – 6737’ 8” ?Siltstone: a clean, silica-cemented coarse siltstone. Similar looking beds in 1-9-17-14W3. They could be mistaken for line mudstone beds. Slight reddish tint in a predominantly light grey rock. Uneven, nodular-like bedding. On a finer scale has mm-thick, irregular, short laminae. Intersected by irregular, rust-coloured layers (Figure 19b).

6737’ 8” – 6738’ 2” Sandstone: Very fine grained. Abrupt basal contact.

6738’ 2” – 6739’ 4” ?Siltstone: a clean, silica-cemented coarse siltstone. Similar looking beds in 1-9-17-14W3.

6739’ 4” – 6747’ 1” Mudstone: slight reddish tint.

6747’ 1” – 6751’ 9” Sandstone: Very fine grained. One/two very thin (1 cm) beds of limestone/dolostone. Very thin to thin beds. Reddish tint. Transitional basal contact.

6751’ 9” – 6755’ 2” Interbedded mudstone-sandstone: A few very thin beds of sandstone in a silty mudstone. Abrupt basal contact.

6755’ 2” – 6763’ Sandstone: Light grey. Very fine grained. A few thin mudstone interbeds. No bioturbation.

Cores 5 to 7: 6784 – 6799.5 ft. 4 boxes.
6799.5 – 6802.5 ft. 1 box.
6802.5 – 6805 ft. 1 box.
6805 – 6820 ft. 4 boxes.
2” diameter core. Full diameter – some slabbed pieces. Generally well preserved.
Examined 10th October 2007.

DEADWOOD FM
Overall coarsening-upward trend
6784 – 6789’ 2” Sandstone: very fine grained. Light grey. Very thin to thick beds. Minor deformation of some very thin beds. At least on example of a sand-ball. No bioturbation. Abrupt basal contact.

6789’ 2” – 6790’ 9” Sandstone: very fine grained. Light brownish grey. Subhorizontal

calcite/dolomite-filled fractures. No obvious internal structures. Abrupt basal contact.

6790' 9" – 6794' 1" Interbedded sandstone-mudstone: Very thin beds of sandstone separated by mudstone beds/layers. Minor deformation. Some lenticular sandstone beds. Transitional basal contact (Figures 19c and d).

6794' 1" – 6795' 1" Mudstone: Interbedded with sandstone near top of interval. Subhorizontal, calcite/dolomite-filled fractures.

6795' 1" – 6796' 2" Interbedded sandstone-mudstone: Very thin to thin beds of laminated sandstone separated by mudstone. Some lenticular sandstone beds.

6796' 2" – 6799' 9" Mudstone: Scattered sandstone beds, increasingly more common in upper 1 ft.

6799' 9" – 6820' Sandstone: very fine grained. A few thin mudstone beds. Light grey. Generally very thin to thin (few cm) beds. Minor load deformation. Some lenticular beds (Figure 19e).

A. Horizontal fractures in shale

B. Interbedded shale - sandstone

C. Horizontal and ripple laminated sandstone

D. Scattered burrowed beds in sandstone

Figure 17. Well 11-3-17-14W3

A. Interbedded burrowed sandstone and mudstone

B. Interbedded sandstone-mudstone

C. Interbedded sandstone-mudstone. Minor bioturbation

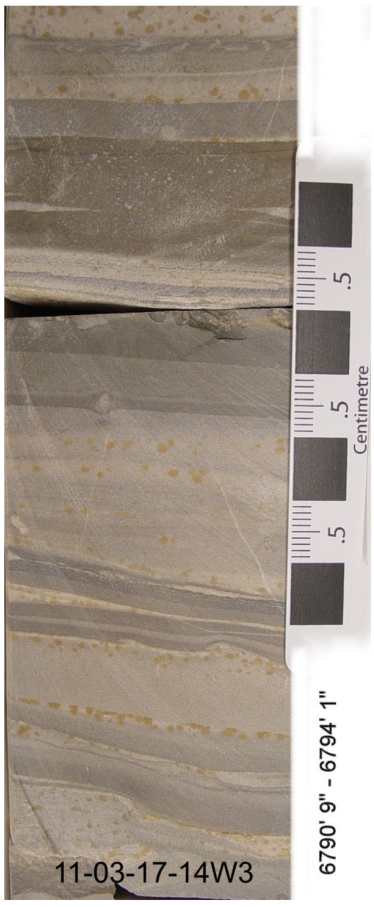
D. Sand-ball

Figure 18. Well 11-3-17-14W3

A. Thinly interbedded sandstone - mudstone

B. Well cemented siltstone to very fine grained sandstone

C. Thinly interbedded sandstone - mudstone



D. Coarse laminae to thin beds of sandstone interbedded with mudstone

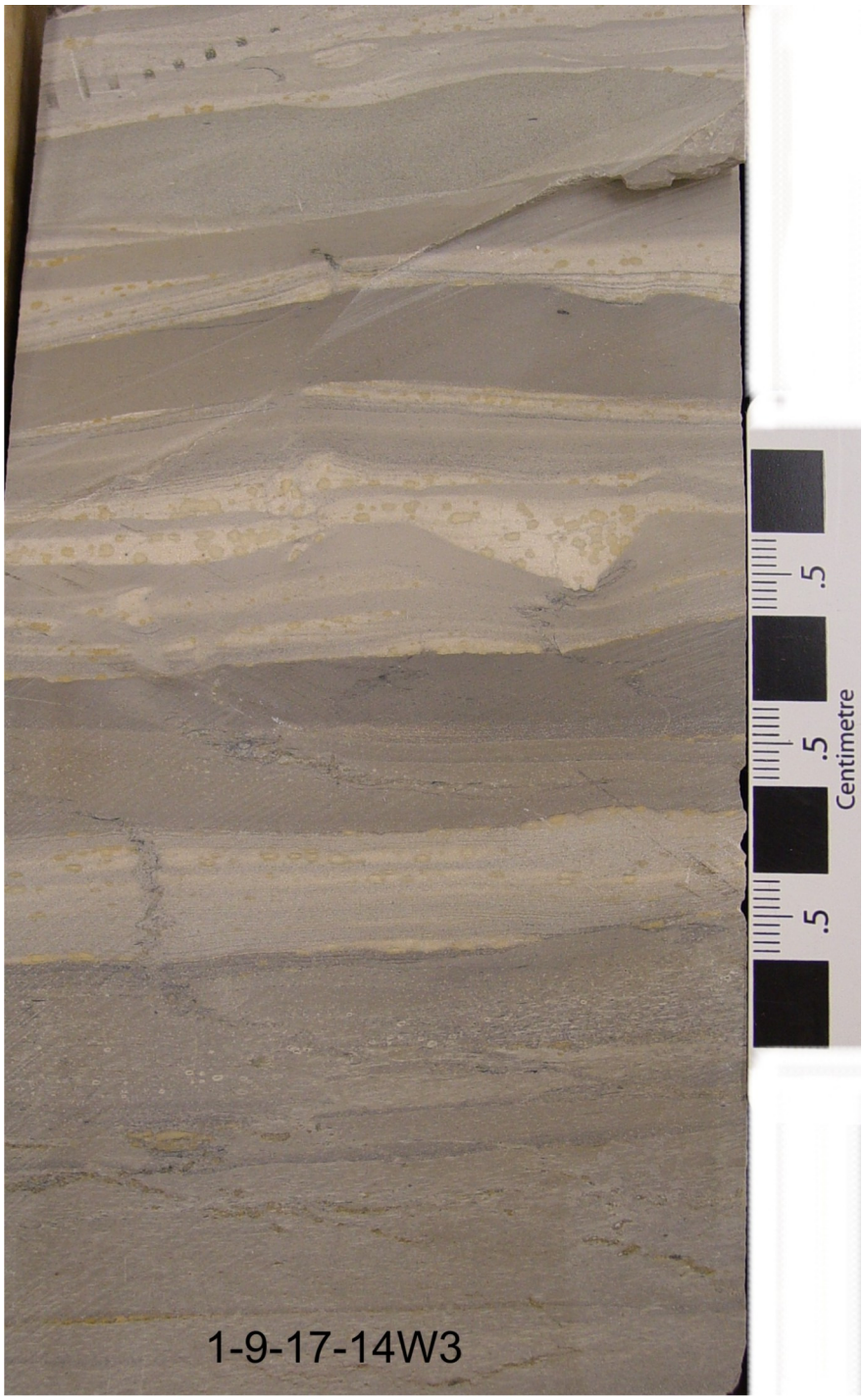
E. Well bedded sandstone

Figure 19. Well 11-3-17-14W3

B.A. Wilhelm 1-9-17-14W3
Core 4: 6575 – 6595 ft. 5 boxes.
Core 5: 6595 – 6645 ft. 10 boxes.
Full diameter with a few slabbed pieces. Well preserved.
Examined 11th October 2007.

DEADWOOD FM

6575' – 6586'	Siltstone: Light grey with a few light brownish grey bands. Scattered very fine grained sandstone in upper 1 ft. Thinly bedded. Some rust-coloured irregular laminae. Superficially looks like a lime mudstone.
6586' – 6595' 6"	Siltstone-sandstone: differs from above by its banded appearance due to alternating light grey and reddish grey or dirty brownish grey. Light grey bands tend to be siltstone and coloured bands very fine grained sandstone.
6595' 6" – 6630'	Siltstone-sandstone: Thin to thick beds of siltstone interbedded with scattered beds of white/light grey, very fine grained sandstone.
6630' – 6645'	Interbedded mudstone-siltstone: Scattered beds of very fine grained sandstone (Figure 20).



6630’ - 6645’ Thin interbeds of mudstone and sandstone

Figure 20. Well 1-9-17-14W3

Gulf Sask. Landing Wilhelm 7-9-17-14W3
Core 1: 6475 – 6489 ft. 3 boxes. Full diameter. Well preserved.
Examined 9th October 2007.

DEADWOOD FM
Light grey, thinly bedded siltstone and silty mudstone (Figure 21).

Very thin interbeds of siltstone and silty sandstone

Figure 21. Well 7-9-17-14W3

BA Sask. Landing Wilhelm 3-10-17-14W3
Core 1: 6483 – 6500 ft. 3 boxes. Full diameter. Recovered 15 ft.
Examined 9th October 2007.

DEADWOOD FM
Fissile greenish grey shale.

PVR Shop Cactus Lake 15-34-34-27W3

Core 2: 2013.8 – 2032 m. 24 boxes (one core length per box). Full diameter with some slabbed pieces. Recovered 18.2 m.
Examined 9th October 2007.

Basal Sandstone Unit

2013.8 – 2014.2 m Sandstone: coarse grained. Cross bedded. Light grey to dirty white. Abrupt basal contact (Figure 22a).

2014.2 – 2014.48 m Sandstone: Beds of fine/medium grained sandstone. Predominantly burrow mottled with some zones that are vaguely burrowed. Some argillaceous zones (Figure 22b).

2014.48 – 2016.05 m Sandstone: Dirty white. Cross bedded. Some brownish stained zones (?oil stained). Abrupt basal contact.

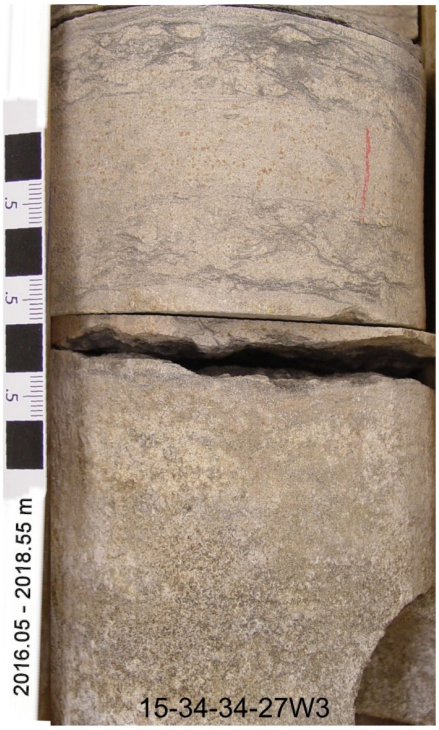
2016.05 – 2018.55 m Interbedded burrowed sandstone and bedded sandstone: Argillaceous burrowed to burrow mottled sandstone is predominant. Greenish hue to burrowed sandstones (?chloritic clays). At least four beds of medium to coarse grained sandstone (Figures 22c and d, Figures 23a and b).

2018.55 – 2032 m Sandstone: granular sandstone grading up into medium/coarse grained sandstone. Cross bedded throughout. Red/maroon colour in basal part of interval (up to about 2022 m) where it changes to a dirty white colour. Some brownish-grey intervals in the white sandstone (possibly oil stain) (Figures 23c and d, Figures 24a and b).

A. Cross bedded, coarse-grained sandstone

B. Burrowed sandstone

C. Interbeds of bedded sandstone and burrowed sandstone

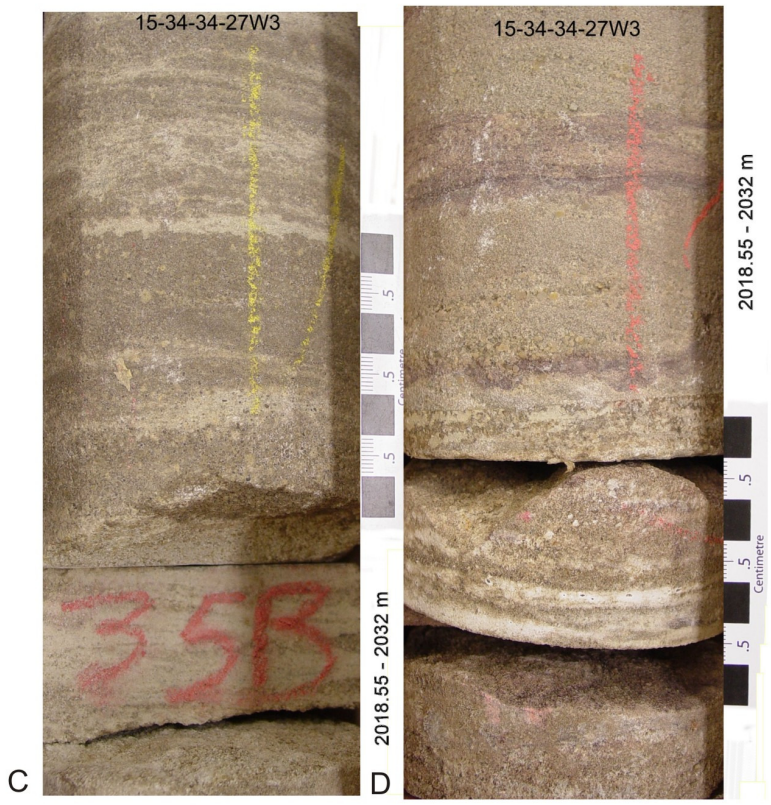


D. Interbeds of bedded sandstone and burrowed sandstone

Figure 22. Well 15-34-34-27W3

A. Bedded and bioturbated sandstone

B. Bedded and bioturbated sandstone overlain by coarse-grained sandstone (arrow)



Cross bedded medium to granular sandstone

Figure 23. Well 15-34-34-27W3

A

B

Medium-grained to granular, cross bedded sandstone. Right-hand photo (B) illustrates change to grey and brownish-grey colours in upper part of interval

Figure 24. Well 15-34-34-27W3

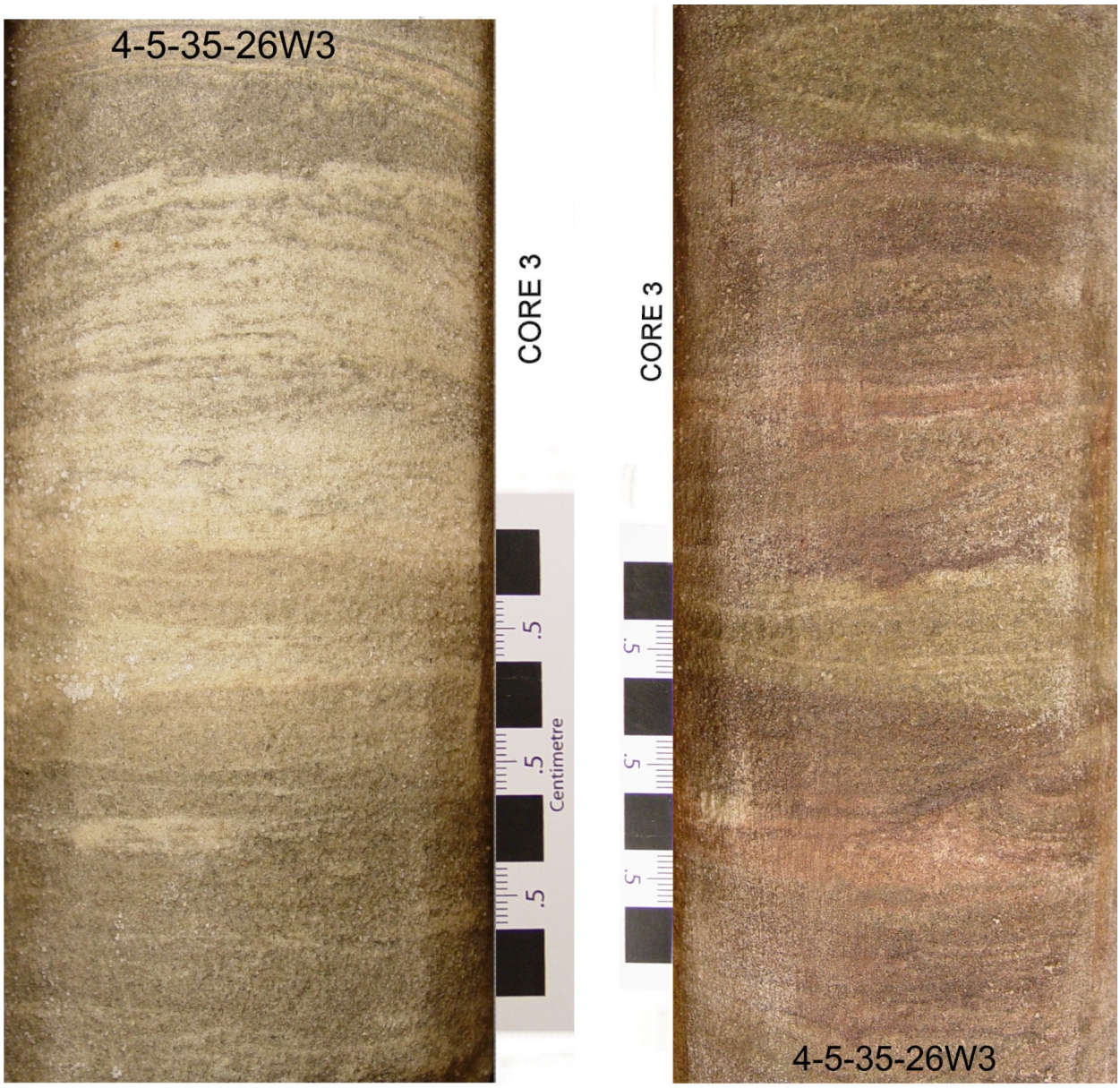
Wascana Plover Lake 4-5-35-26W3
Core 3: 2032 – 2050.35 m. 16 boxes. Full diameter. Well preserved.
Examined 11th October 2007.

Core is coated with what appears to be salt crystals – presumably from the drilling mud.

BASAL SANDSTONE UNIT
Sandstone: medium to coarse grained. Cross-bedded throughout core. Alternating zones of white and maroon coloured sandstone – colour changes usually gradational. Multiple beds. Some possible very small vertical burrows. (Figures 25a and b, Figure 26a).

Maroon-coloured sandstone; colour appears to be due to a red coloured cement (oxidized clay perhaps) which reduces porosity. At least one deformed bed in a maroon-coloured sandstone (Figure 26b).

White-coloured sandstone: Very porous. Less cemented than maroon examples.

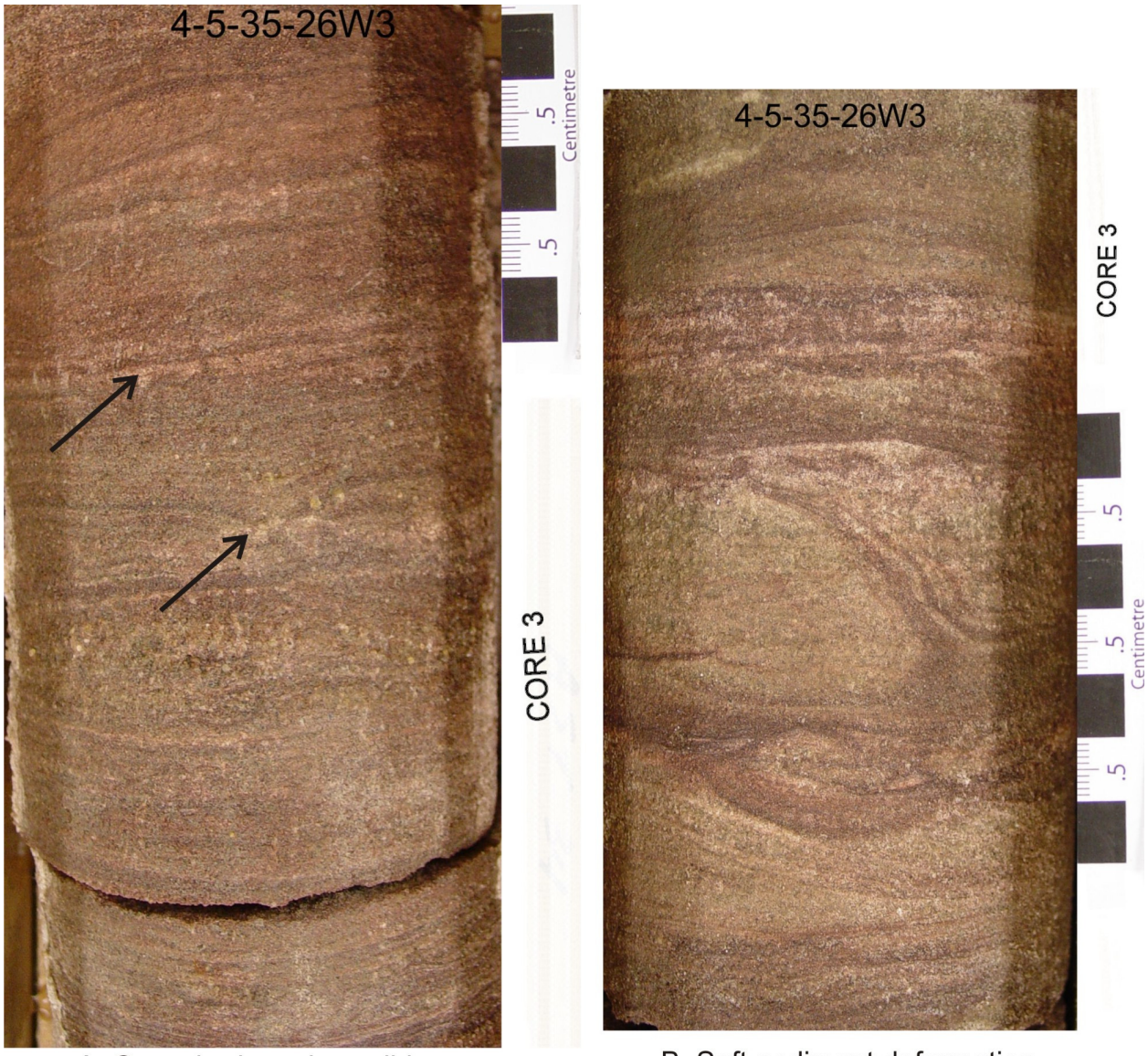


A. Cross bedded white sandstone

B. Cross beds and ripple laminae in red sandstone

Examples of facies in core 3

Figure 25. Well 4-5-35-26W3



A. Cross beds and possible very small burrows (arrows)

B. Soft-sediment deformation

Examples of facies in core 3

Figure 26. Well 4-5-35-26W3

Wascana Luseland 3-18-36-25W3
Core 1: 1977 - 1995.25 m. Full diameter. Well preserved. Lots of core plugs.
Examined 10th October 2007.

Basal Sandstone Unit

1997 - 1981.88 m Sandstone: medium to coarse grained, locally very coarse to granular. Maroon and white colours, former predominant. Multiple sets of trough cross beds (Figures 27a and b). Very porous. Base of interval rests abruptly on thin, dark maroon mudstone (Figure 27c).

1981.88 - 1981.89 m Mudstone: dark maroon. Transitional basal contact.

1981.89 - 1982.93 m Sandstone: similar to above. Trough cross beds. Basal 1 cm contains scattered large granules. Abrupt basal contact.

1982.93 - 1982.99 m Mudstone: dark maroon. Silty to sandy. Abrupt basal contact (Fig. 27d).

1982.99 - 1983.04 m Sandstone: Coarse grained. White with reddish tint. Abrupt basal contact.

1983.04 - 1983.09 m Mudstone: dark maroon. Silty. Thin sandstone bed near top of interval. Abrupt basal contact.

1983.09 - 1985.36 m Sandstone: as above. Multiple sets of cross beds - either separated by scours or thin mudstone beds (15 - 70 cm thick). Possible ripple laminae at the top of one thin sandstone beds (Figure 28a). White more prevalent than red colour.

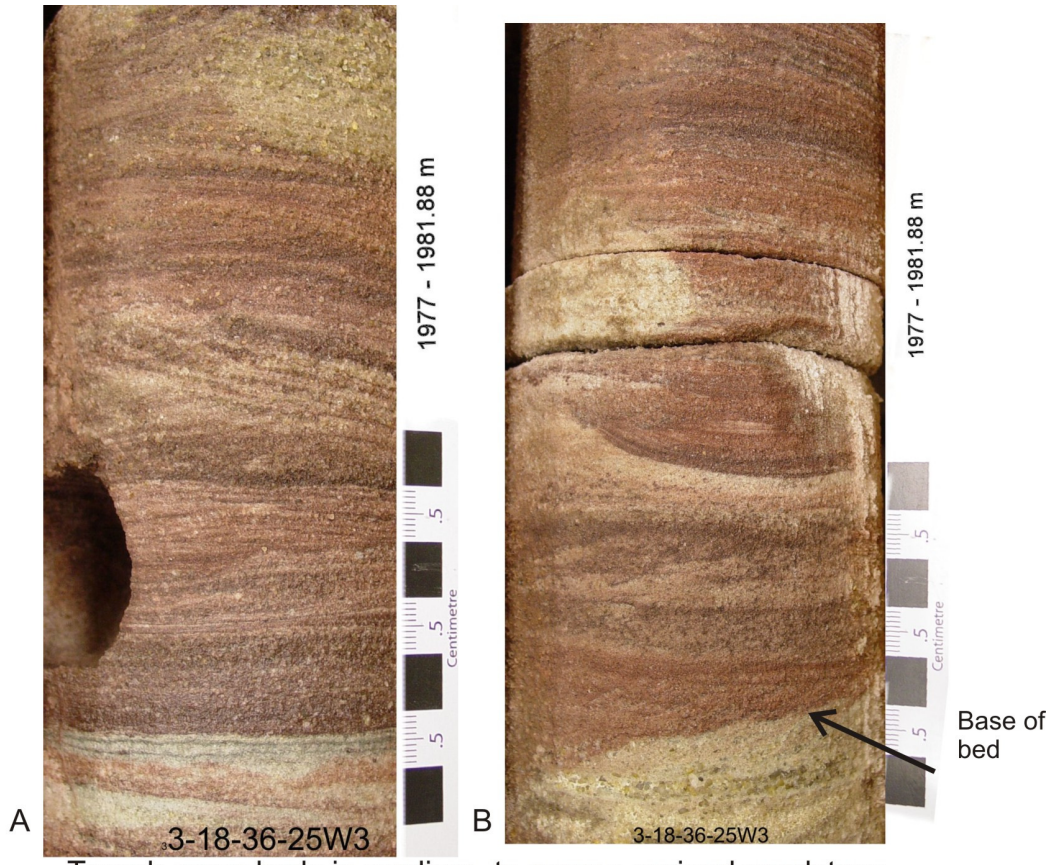
1985.36 - 1986.45 m Interbedded mudstone-sandstone: Predominantly red mudstone with thin lenses of sandstone and three thicker sandstone beds. Small horizontal burrows in the mudstone units (Figure 28b).

1986.45 - 1987.39 m Sandstone: as above. Maroon coloured with some whitish zones. Cross bedded.

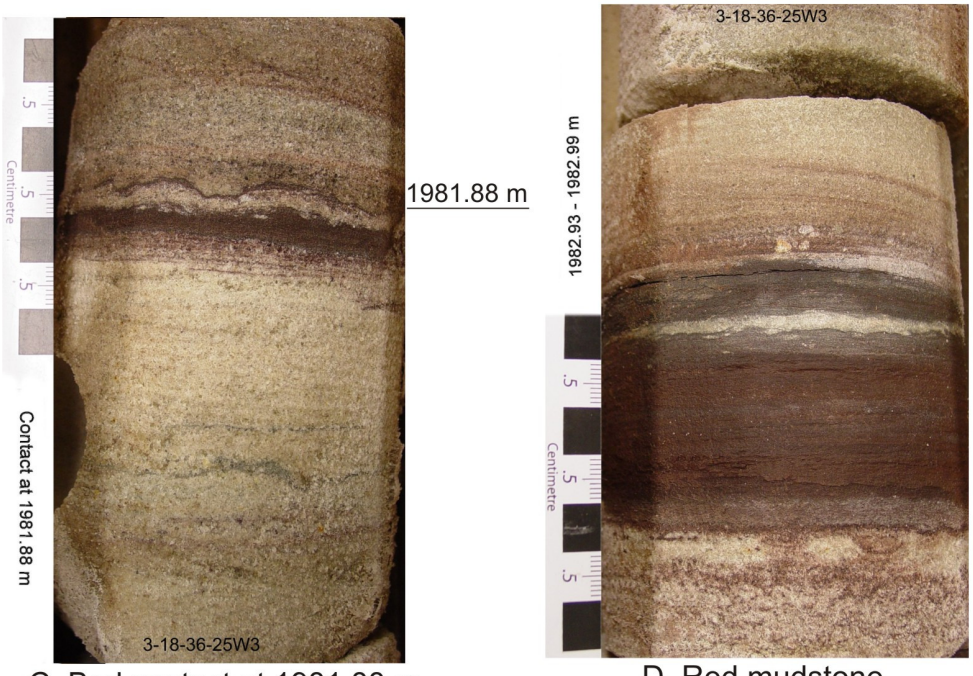
1987.39 - 1987.61 m Interbedded sandstone-mudstone: Maroon coloured. Thin sandstone beds separated by mudstone. Overall sanding-up aspect. Abrupt basal contact.

1987.61 - 1989.38 m Sandstone: medium to coarse grained, locally very coarse. Trough cross beds (Figure 29a). Maroon coloured. Abrupt basal contact (Fig. 29b).

1989.38 - 1995.25 m Sandstone: White. Medium to coarse grained, locally some small granules. Sets of cross bed (Figure 29c). Units appear to be separated by black shale layers and at least one 7 cm thick mudstone bed at 1990.6-1990.67 m. Possible burrows (Figure 29d).



Trough cross beds in medium- to coarse-grained sandstone



C. Bed contact at 1981.88 m

D. Red mudstone

Figure 27. Well 3-18-36-25W3

A. Small sand lenses in muddy strata

B. Sand-filled burrows in a mudstone bed

Figure 28. Well 3-18-36-25W3

A. Trough cross beds

B. Base of a cross-bedded unit

C. Cross beds

D. Thin sandstone beds separated by mudstone laminae

Figure 29. Well 3-18-36-25W3

Saskoil Shop Luseland 16-36-36-25W3
Core 3: 1934 – 1943 m. 6 boxes. Full diameter. Moderately well preserved.
Examined 9th October 2007.

Basal Sandstone Unit

1934 – 1934.67 m Sandstone: medium to coarse grained. Well rounded grains. White. Abrupt basal contact. Probably multiple beds. Some intersecting medium angle cross bedding in upper part of interval. Horizontal bedding in lower few cm.

1934.67 – 1934.85 m Sandstone: Thin sandstone beds (1 - 2 cm) separated by mud layers. One 1.5 cm thick mudstone bed about 8 cm above base (Figure 30a). Some horizontal burrows especially in muddy beds.

1934.85 – 1935.66 m Sandstone: Medium grained. White. Medium angle cross beds in lower third and upper 15 cm. Middle zone difficult to detect any sedimentary structures. Abrupt basal contact (Figure 30b).

1935.66 – 1936.07 m Sandstone: burrow mottled. Irregular mud laminae between mottled sand. (Figure 30c).

1936.07 – 1939.47 m Sandstone: medium to coarse grained, locally contains some small granules. White. Quartz-dominant. Cross bedded throughout (possibly trough cross beds). Probably multiple beds (Figure 30d).

1939.47 – 1943 m Sandstone: similar to overlying sandstone but differs by the occurrence of some brick-red layers and a thin red mudstone bed about 48 cm above base of core (Figure 31).

A. Thin interbeds of sandstone and mudstone. Some small burrows

B. Cross bedded sandstone

C. Burrow-mottled sandstone

D. ?Trough cross bedded sandstone

Figure 30. Well 16-36-36-25W3

A. Cross bedded, red sandstone

B. Mudstone laminae and thin beds interbedded with sandstone

Figure 31. Well 16-36-36-25W3

Ceepee Reward 4-28-38-24W3
Examined 10th October 2007.

Core 11: 5200 – 5209.5 ft. 2 boxes. Full diameter

Core 12: 5209.5 – 5225 ft. 4 boxes. Full diameter.
Core broken into numerous pieces due to fissile nature of shale.
DEADWOOD FM
Predominantly greenish grey shale with scattered laminae and very thin beds of very fine grained, laminated sandstone. In box 3 of core 12, there is a flat-pebble conglomerate (Figure 32a).

Core 13: 5384 – 5409 ft. 6 boxes. Slabbed. Well preserved.
DEADWOOD FM

5384' – 5390' 10" Interbedded sandstone-mudstone: very fine to fine grained sandstone in lenticular and very thin beds. Predominantly ripple laminated sandstone beds separated by mm to 1 cm thick mudstone layers. A few very small burrows. Some minor bed deformation (Figure 32b).

5390' 10" – 5392' Shale: medium to dark grey. Some very thin beds of very fine grained sandstone in basal 6 inches.

5392' – 5409' Interbedded sandstone-mudstone: cf. as above. Contains a 4 inches thick bed of flat-pebble conglomerate in box 3 (Figure 32c). Minor, scattered occurrences of horizontal burrows.

Core 14: 5565 – 5590 ft. 6 boxes. Slabbed. Well preserved.
DEADWOOD FM

5565' - 5565' 11" Shale: fissile. Reddish grey.

5565' 11" – 5567' Interbedded sandstone-mudstone: Slight greenish colour. Mostly thoroughly bioturbated and load deformed beds with some preserved very thin beds in top and lower 4 inches of interval. (Figures 32d and e).

5567' 5570' 5" Shale: fissile. Reddish grey. Contains a zone of bioturbated and laminated sandstone near top of interval. Basal part of shale interval is greenish grey and rests abruptly on underlying bed.

5570' 5" – 5571' 7" Interbedded sandstone-mudstone: Sandstone predominant. Very fine to fine grained. Mostly laminated. One bed contains a ptygmatic injected sandstone vein (Figure 32f).

5571' 7" – 5574' 9" Shale: fissile. Reddish grey.

5574’ 9” – 5575’ 8” Sandstone: some mudstone interbeds. Very fine to fine grained. Finely laminated. Some deformation.

5575’ 8” – 5577’ Shale: fissile. Reddish grey.

5577’ – 5579’ 3” Interbedded sandstone-mudstone: cf. other similar intervals. Minor amounts of burrowing in at least one mudstone. Minor load deformation. Abrupt basal contact.

5579’ 3” – 5583’ 11” Shale: fissile. Reddish grey. A few very thin interbeds of very fine grained sandstone.

5583’ 11” – 5585’ 3” Interbedded shale-sandstone: Very thin to thin beds of very fine grained sandstone interbedded with green and reddish grey shale. One of the thicker sandstone beds is load deformed.

5585’ 3” – 5585’ 9” Sandstone: severely load deformed bed of very fine to fine grained sandstone. Steeply deformed basal contact.

5585’ 9” – 5587’ 8” Mudstone: greenish grey. Laminae to very thin beds of very fine grained sandstone. Contains a thick sandstone dyke (Figure 33a). Abrupt basal contact.

5587’ 8” – 5588’ 8” Sandstone: Very fine grained. Vaguely bedded. Abrupt basal and upper contacts.

5588’ 8” – 5590’ Mudstone: Greenish grey. Contains a zone with very thin beds of sandstone.

Core 15: 5808 -5833 ft. 5 boxes. Slabbed. Well preserved.
DEADWOOD FM
Thinly interbedded mudstone and sandstone. Very fine grained sandstone. Beds generally <2 cm thick, with a few thicker (up to 8 cm) beds. Sandstone beds mostly finely laminated (horizontal and small ripple laminae). Some lenticular sand beds. Sand-filled horizontal burrows common in mudstones (Figures 33b, c, and d).

Core 16: 6018 – 6043 ft. 6 boxes. Slabbed. Well preserved.
EARLIE FM
6018’ – 6031’ Interbedded mudstone-sandstone: Extensively bioturbated such that only a few beds contain preserved original laminae (Figures 33f and g). Greenish grey mudstone (probably due to chloritic clay content). Sandstones are

very fine to fine grained, with black chert and quartz.

6031' – 6035' Sandstone: very fine to fine grained. Slight greenish tint in a dominantly dirty white colour. Quartz and black chert grains. Burrow mottled (Figure 34a).

6035' – 6037' 6" Interbedded sandstone-mudstone: cf. above. Sandstone predominant.

6037' 6" – 6040' 6" Sandstone: cf. above.

6040' 6" – 6043' Interbedded sandstone-mudstone: cf. above (Figure 34b).

Core 17: 6192 – 6227 ft. 8 boxes. Slabbed. Well preserved.
EARLIE FM

6192' – 6193' 10" Interbedded sandstone-mudstone: very thin to thin beds of bioturbated fine grained sandstone and mudstone. Slightly more sandstone than mudstone. A few sandstone beds with preserved laminae. Horizontal and vertical burrows, former more prevalent (Figures 34c and d). Upper beds in Figure 34d may be syneresis cracks (Figure 2 in Pratt, 1998). Abrupt basal contact.

6193' 10" – 6195' 8" Sandstone: Fine grained. Argillaceous. Burrow mottled. Most of original bedding destroyed. Abrupt basal contact (Figure 35a).

6195' 8" – 6200' 7" Sandstone: Fine grained with a few scattered beds of medium grained sandstone. Greenish white colour. Multiple beds separated by mm-scale layers of clay laminated sandstone or sand laminated mudstone. Beds 5 – 10 cm thick. Several beds have planar cross beds. Vertical and horizontal burrows in clayey intervals (Figures 35b and 36a).

6200' 7" – 6205' 9" Interbedded sandstone-mudstone: Beds up to10 cm thick. Some sandstone beds appear to have load deformed bases (Figure 35c). Fine grained sandstone. Burrowed. Some clay laminae (Figure 35d).

6205' 9" – 6206' Sandstone: Very fine to fine grained. Burrow mottled.

6206' – 6209' 10"` Sandstone: Fine grained sandstone beds separated by clay laminated zones or mm-thick mudstone layers. Thinner sandstone beds and the mudstone tend to be burrowed (mostly horizontal). Thicker sandstone beds (up to 10 cm thick) contain planar cross beds, commonly capped by a clay-laminated sand. Cross beds probably formed by mega-ripples or small, migrating sand waves – some of the clay laminated zones have small-scale ripple (Figure 36b).

6209’ 10” – 6211’ 6” Sandstone: Very fine to fine grained. Burrow mottled. A few patches of remnant laminae.

6211’ 6” – 6213’ 4” Interbedded sandstone-sandy mudstone: Predominantly fine grained sandstone. Sandstone beds a few cm thick, separated by burrowed sandy mudstone or clay laminated sand. A few sandstone beds with planar cross beds (large ripple?).

?Basal Sandstone Unit

6213’ 4” – 6227’ Sandstone: Medium to coarse grained sandstone beds separated by clay laminated zones or scour surfaces. In lowermost part of interval the sandstone has a reddish tint. Planar cross beds and horizontal laminae preserved in some beds. (Figures 36c and d, Figure 37a). Minor occurrences of burrowing, usually where clay is present. Porous.

NOTE: the major log character shift (gamma-ray) at 6208 ft. does not appear to be reflected by any significant lithological change other than the burrow mottled sandstone at 6209’ 10” – 6211’ 6”. Possible core depth for top of Basal Sandstone Unit may be at 6213’ 4” where there is a significant change in sandstone type.

Core 18: 6405 – 6410 ft. 1 box. Slabbed. Generally well preserved.

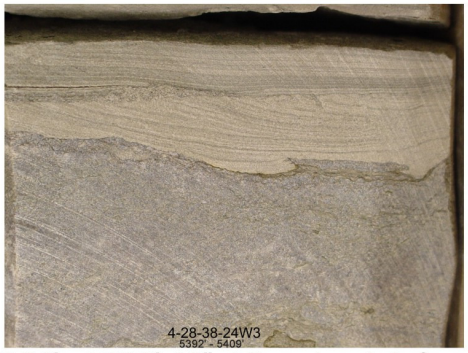
Basal Sandstone Unit

Coarse to very coarse grained sandstone. A few clay layers present. Tangential and planar cross beds. Multiple thin beds, up to 10 cm thick, usually separated by scour surfaces (Figures 37b, c, and d).

Reference:

Pratt, B.R. 1998. Syneresis cracks: subaqueous shrinkage in argillaceous sediments caused by earthquake-induced dewatering. Sedimentary Geology, v.117, p. 1–10.

A. Core 12: flat-pebble conglomerate



B. 5384' - 5390' 10": Minor load deformation

C. Flat-pebble conglmerate

D. Interbedded mudstone-sandstone. Deformed burrows

E. Deformed sandstone bed

F. Small-scale sandstone dyke (arrow)

Figure 32. Well 4-28-38-24W3

A. Sandstone dyke

B. Bioturbated beds of mudstone and sandstone

C. Lenticular sandstone beds

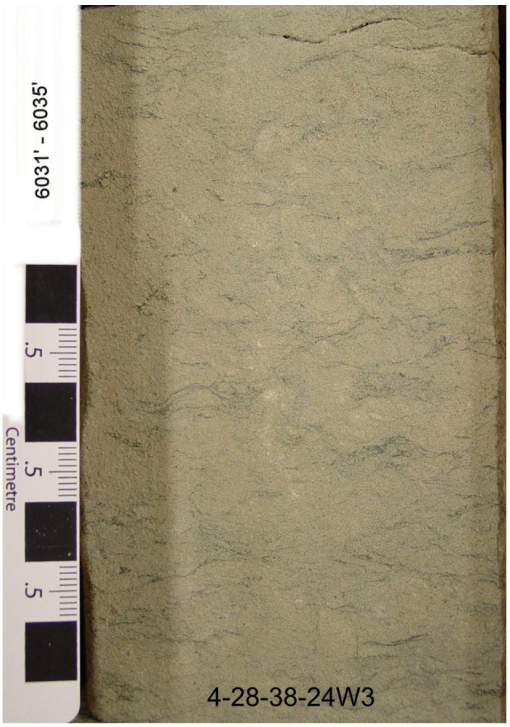
F. 6018' - 6031' Burrow mottled muddy sandstone

D. Ripple laminated sandstone interbedded with mudstone

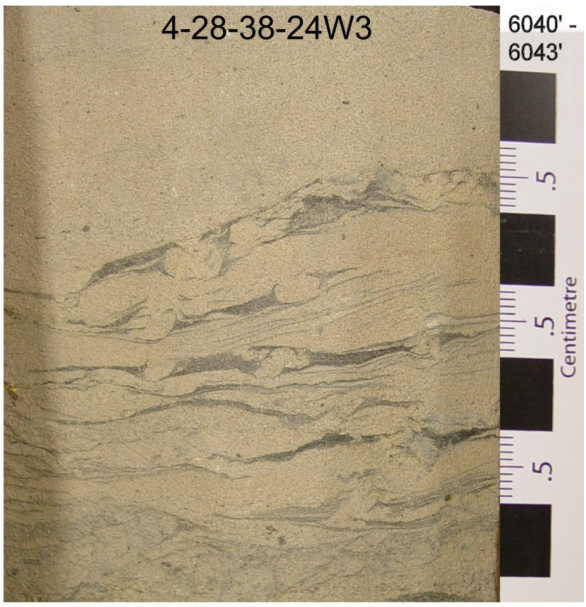
E. Interbedded burrowed sandstone and mudstone

G. Burrow mottled muddy sandstone

Figure 33. Well 4-28-38-24W3



A. Burrow mottled sandstone



B. Burrowed sandstone and mudstone

C. Interbedded, burrowed, mudstone and sandstone

D. Interbedded, burrowed, sandstone and mudstone

Figure 34. Well 4-28-38-224W3

A. Burrow mottled sandstone

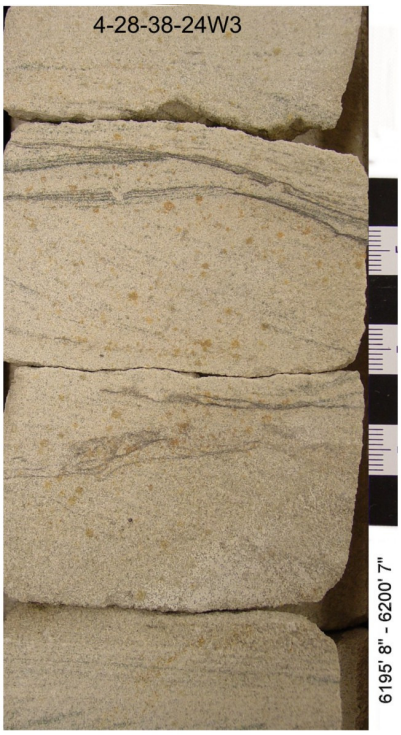
B. Load deformed laminated sandstone

C. Cross bedded sandstone

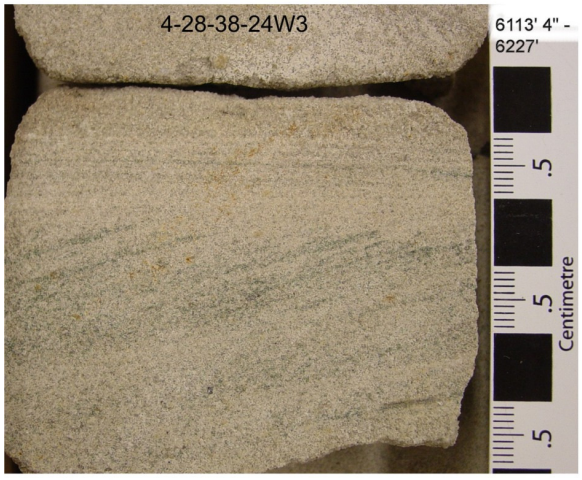
D. Burrowed, interbedded sandstone and mudstone

Figure 35. Well 4-28-38-24W3

A. Thin sandstone beds separated by mm-thick mudstone layers. Minor biouturbation



B. Thin sandstone beds separated by mm-thick mudstone layers



C. Cross bedded sandstone

D. Well bedded sandstone

Figure 36. Well 4-28-38-24W3

A. Cross bedded sandstone

B. Core 18: thin mudstone layers separating sandstone beds

C. Core 18: cross bedded sandstone

D. Core 18: cross bedded sandstone

Figure 37. Well 4-28-38-24W3

Ceepee Riley Lake 3-4-39-13W3
Examined 10th October 2007.

Core 12: 5065 – 5095 ft. 6 boxes. Full diameter. Well preserved.
DEADWOOD FM

5065' – 5066' Shale: greenish grey. Badly broken core.

5066' – 5067' 7" Sandstone: very fine grained. Finely laminated (subhorizontal and some ripple-like laminae near top of interval) No bioturbation. Abrupt basal contact.

5067' 7" – 5068' 2" Mudstone: laminae and very thin beds of very fine grained sandstone. No bioturbation.

5068' 2" – 5069' 6" Sandstone: similar to above. Minor mudstone layers.

5069' 6" – 5071' 2" Mudstone: minor sandstone laminae.

5071' 2" – 5079' 9" Sandstone: Scattered very thin beds/layers of mudstone. Multiple beds that are erosionally based, finely laminated in lower part grading up into ripple laminated mud-sand laminae. A few beds grade up into mudstone. No bioturbation noted (Figure 38a and b).

5079' 9" – 5095' Shale: greenish grey. A few very thin beds of very fine grained sandstone and scattered sand laminae.

Core 13: 5365 – 5390 ft. 6 boxes. Full diameter. Well preserved.
DEADWOOD FM

Thinly interbedded sandstone-mudstone. Very fine grained sandstone in beds a few mm to a maximum of 12 cm, but most beds are <2 cm thick. Sandstones usually finely laminated (horizontal and ripple laminae). Tends to sand-up; bottom 5 ft. shalier than rest of interval. Only a few burrows seen (Figure 38c).

Core 14: 5724 – 2754 ft. 6 boxes. Full diameter. Well preserved.
EARLIE FM

5724 – 5728' 8" Interbedded sandstone-mudstone: Sandstone predominant and occurs in very thin to thin beds separated by mudstone layers. Finely laminated sandstones (horizontal and current-ripple laminae). A few muddy beds with sand-filled horizontal burrows.

5728' 8" – 5728' 9.5" Sandstone: coarse grained. Black chert is prominent component. Contains mudstone clasts 1-2 cm long. Abrupt base and top (Figure 38d).

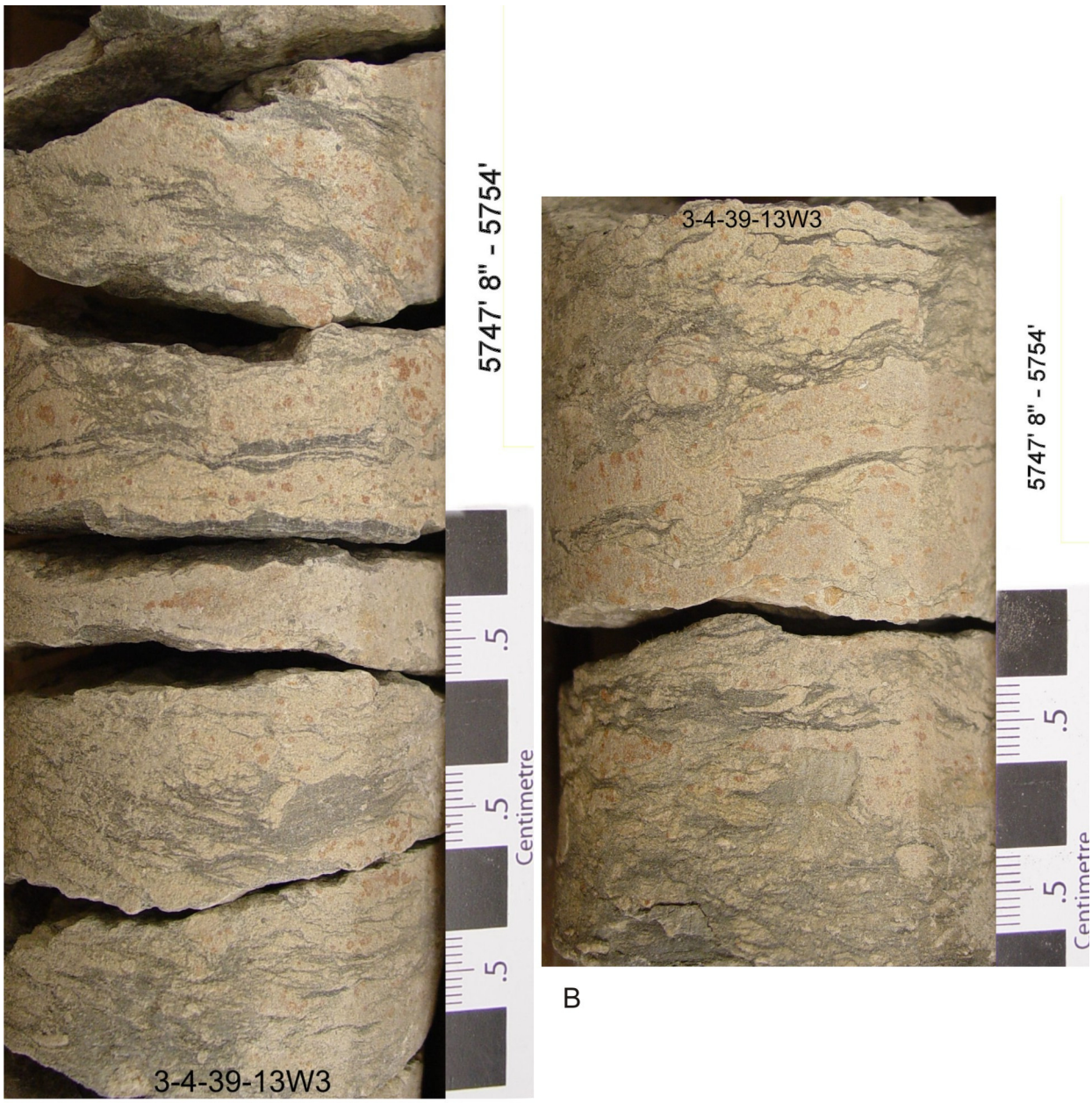
5728’9.5” – 5729’5” Argillaceous sandstone: bioturbated.

5729’5” – 5729’ 6.5” Sandstone: coarse grained. Black chert prominent component. Abrupt base and top.

5729’ 6.5” – 5747’ 8” Sandstone: very fine grained. Multiple burrowed muddy sandstone zones separating thick sandstone beds.

5747’ 8” – 5754’ Sandstone: Bioturbated. Very fine to fine grained. Irregular lenses and laminae of green mudstone due to extensive bioturbation (Figure 39).

Figure 38. Well 3-4-39-13W3



A

B

Extensively burrowed sandstone and mudstone

Figure 39. Well 3-4-39-13W3

Ceepee Keppel Forest 8-3-40-14W3
Examined 10th October 2007.

Core 12: 4990 – 5015 ft. 6 boxes. Full diameter. Well preserved.

DEADWOOD FM

4990' - 4996' 6" Interlaminated to interbedded shale-sandstone: Greenish grey colour. Very fine grained sandstone – occurs as laminae in the shale, very small lenses (mm-scale) to very thin laminated beds. A few horizontal burrows.

4996' 6" – 4996' 8.5" Flat-pebble conglomerate: mudstone clasts in a very fine to fine sand matrix with scattered coarse grains. Abrupt basal and upper contacts. A large laminated sandstone clast near base (Figure 40a).

4996' 9.5" – 4999' 3" Interlaminated to interbedded sandstone-mudstone: as above. Abrupt basal contact.

4999' 3" – 5003' Sandstone: very fine to fine grained with a few very thin mudstone layers or sand-laminated mudstone. Very finely laminated sandstone; a few lenticular sandstones associated with the sand-laminated mudstone zones. Some ripple laminae. Beds vary in thickness from a 1 cm to about 15 cm. Thicker beds more common in lower part of interval.

5003' – 5005' 9" Interbedded mudstone-sandstone: mudstone dominant. As above.

5005' 9" – 5013' Interlaminated to interbedded sandstone-mudstone: Sandstone dominant. [PHOTO]. Cf. above, but differs in having two mudstone interval with sand-filled horizontal burrows (Figures 40b and c).

5013' – 5015' Mudstone: core broken into small pieces

Core 13: 5203 – 5210 ft. 2 boxes. Full diameter. Poor preservation.
Upper part of core badly broken and poorly preserved.

DEADWOOD FM

Interbedded mudstone-sandstone: predominantly mudstone with lenses and very thin beds of very fine grained sandstone. Sand-filled horizontal and vertical burrows common (Figure 40d, Figures 41a and b).

Core 14: 5488 – 5513 ft. 6 boxes. Full diameter. Well preserved.

DEADWOOD FM

Interlaminated to interbedded sandstone-mudstone: sandstone prevalent lithology. Sandstone

occurs in laminae within mudstone beds and beds up to 18 cm thick. Thicker beds are more common in lower third of core. More mudstone in upper third of core. Sandstone is mostly very fine to fine grained with isolated very thin beds (1-4 cm) of medium/coarse grained sandstone. Sandstone beds mostly finely laminated. Some thin beds have ripple laminae. A few rippled beds have basal load structures. Vertical and horizontal burrows tend to be concentrated in a few mudstone beds scattered throughout the core (Figures 41c, d, and e).

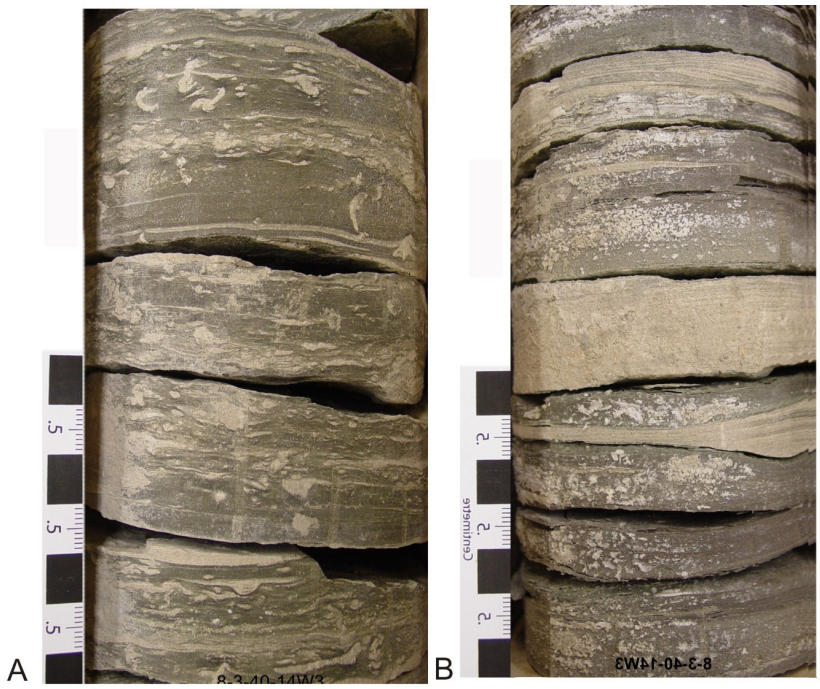
A. Flat-pebble conglomerate

B. Interlaminated to interbedded mudstone and sandstone

C. Sandstone with burrowed interbeds of mudstone

D. Core 13: extensively burrowed mudstone and sandstone

Figure 40. Well 8-3-40-14W3



A B

Typical facies in Core 13: predominantly mudstone with abundant sand-filled burrows (A) and a few thin, ripple-lamianted sandstone interbeds (B)

D E

Typical facies in core 14:Predominantly sandstone with thin mudstone interbeds.

C

Figure 41. Well 8.3-40-14W3

Husky Lloyd 12-30-49-27W3
Examined 11th October 2007.

Core 4: 1634 – 1642 m. 6 boxes.
Core 5: 1642 – 1649.25 m. 6 boxes.
Full diameter with some slabbed pieces. Well preserved.

Basal Sandstone Unit

1634 – 1644.90 m — Sandstone: Fine to medium grained; some coarse grained. Alternating white and maroon coloured intervals. Cross bedded. Multiple, scour-based beds: Cross bedded sandstone overlain by ripple laminated sandstone in turn overlain by mudstone (latter not commonly preserved). Bed thickness is variable, up to 50 cm. (Figures 42a, b, and c). Red coloration more common in upper part of interval, or where clay laminae are present. Abrupt basal contact (Figure 42d).

1644.90 – 1649.25 m — Sandstone: White. Medium to coarse grained. Cross bedded. Some beds grade up into clay laminae or thin mudstone beds (Figure 42d).

Core 6: 1652 – 1666 m. 20 boxes (single core length in each box). Full diameter. Well preserved.

Basal Sandstone Unit

Sandstone: White. Medium to coarse grained. Locally very coarse to granular. Porous. Cross bed sets. Some units separated by mudstone beds. Minor bioturbation in some of the thicker mudstone units.
Thick beds consist of, from base-to-top: cross bedded sandstone – clay laminated sandstone – mudstone (latter not always present) (Figure 43).

A. White and red cross bedded sandstone

B. Clay laminated sandstone overlying cross bedded sandstone

C. Ripple laminated sandstone overlying cross bedded sandstone

D. Contact between a red and a white sandstone interval

Figure 42. Well 12-30-49-27W3

A. Fining-up bed: cross bedded medium to coarse-grained sandstone grading up into a mud-laminated fine grained sandstone, in turn erosionally overlain (arrow) by a coarse-grained sandstone

B. Thin beds of coarse-grained to granular sandstone

Fig. 43. Well 12-30-49-27W3

Canadian Seaboard Divide #2 7-14-56-17W3

Cores examined 10th October 2007.

Cores 6 and 7: 2920 - 2928 ft. 2 boxes. Full diameter
2928 - 2952 ft. 5 boxes. Full diameter.

DEADWOOD FM

Predominantly red-coloured silty shale with some greenish-grey silty shales towards base of core. In box 5 of core 7 there are fragments of red-coloured very fine grained sandstone (Figure 44a).

Core 8: Not available

Core 9: 3204 - 3206 ft. 1 box.

EARLIE FM

Loose, very fine grained white sand and a few lumps of semi-cohesive sandstone.

Core 10: 3428 - 3444 ft. 3 boxes. Full diameter.

EARLIE FM

Interbedded greenish grey mudstone and laminae to very thin beds of coarse siltstone to very fine grained sandstone. Fine laminae and ripple laminae in sandy beds (Figure 44b).

Core 11: 3787 - 3806 ft. 4 boxes. Full diameter.

EARLIE FM

3787 - 3788' 11" Sandstone: very fine to fine grained, argillaceous, red coloured. Probably arkosic. Basal contact not preserved but there is an abrupt colour change.

3788' 11" - 3806 ft. Sandstone: green coloured, very fine to fine grained, argillaceous, probably glauconitic. Bioturbated throughout - mostly horizontal burrows (Figures 44c and d).

A. Typical facies of cores 6 and 7: red shale with fine laminae of sand/silt

B. Core 10: interbedded mudstone-sandstone

C. ?Arkosic very fine to fine-grained sandstone

D. Burrow mottled, glauconitic, argillaceous sandstone

Figure 44. Well 7-14-56-17W3

Seaboard Meadow Lake #1 13-21-61-15W3

Cores 5 – 16: 2289 – 2349 ft. 1 box. Small diameter core (1.5 ins). Poorly preserved.
Examined 11th October 2007.

Basal Sandstone Unit
Only small bits of core preserved. Bright brick-red, very fine to fine grained sandstone. Grains are subangular.

Core 17: 2394 – 2409 ft. 2 boxes.
Core 18: 2409 – 2437 ft. 3 boxes.
Full diameter. Poorly preserved.
Examined 11th October 2007.

Basal Sandstone Unit
Broken into small fragments, or short core segments. Dark maroon red to reddish white zones of mostly fine grained sandstone. Sub-angular to sub-rounded sands grains. Red colour is in the matrix/cement. Some horizontal bedding preserved in a few core segments.

Great Plains et al. Musquash 8-8-64-2W3

Core 1: 1906 – 1921 ft. 3 boxes
Core 2: 1921 – 1945 ft. 4 boxes
Full diameter.. Well preserved.
Examined 11th October 2007.

Basal Sandstone Unit

1906 – 1910' 7"	Interbedded sandstone-mudstone: Thin interbeds. Grey to greenish grey. Some ripple laminae preserved. Mostly fine grained sandstone with a few thin beds of medium to coarse grained sandstone (Figure 45a). Abrupt colour change across basal contact.
1910' 7" – 1945'	Interbedded sandstone-mudstone: similar to above but with more mudstone and a brick-red colour (Figures 45c, d, and e). Some burrowed beds.

Core 3: 1972 – 1945 ft. 2 boxes. Full diameter. Moderately well preserved.
Basal Sandstone Unit
Preserved as short core segments. Brick-red fine to medium grained sandstone. Mostly quartz grains in a red matrix/cement. Traces of cross bedding. A few thin red mudstone beds.

A. Interbedded sandstone and mudstone with scattered beds of coarse-grained sandstone

B. Same as below

C

D

E

Very thin interbeds of sandstone and mudstone with some burrow structures.

Figure 45. Well 8-8-64-2W3

B.A. Dove Lake 13-18-65-11W3
Core 1: 1961 – 2011 ft. 11 boxes. Full diameter. Well preserved.
Examined 11th October 2007.

Basal Sandstone Unit

1961' 1973' 2" — Interbedded sandy mudstone-mudstone-sandstone: Brick-red with some greenish grey zones (Figure 46a).

1973' 2" – 2007' 9" — Arkosic sandstone: Brick-red and some greenish coloured sandstone. Medium to coarse grained with scattered very coarse to large granules of feldspar; latter tend to be more common in lower 7 ft. (Figures 46b and c). Red colour is in the cement/matrix. Sandstone mostly quartz but some feldspar and chert. Vaguely bedded.

2007' 9" – 2011' — Conglomerate: Small to large quartz pebbles (up to 2 cm) in a clay to sand matrix. Clasts sub-rounded to sub-angular (Figure 46d). Reddish colour in lower third; brownish grey in upper two-thirds.

A. Interbedded red mudstone and sandstone

B. Mudstone-sandstone bed contact

C. Small angular pebbles of feldspar in arkoic sandstone

D. Large granules to small pebbles of quartz in an arkosic sandstone

Figure 46. Well 13-18-65-11W3