A

Map location number 1
STANOLIND 1 CLARK
API 40 063 05067
NE NE sec. 11, T. 22 N., R. 2 E.
Harding County, South Dakota
Kelly bushing elevation: 3,047 ft
Ground surface elevation: 3,035 ft
Log types shown: spontaneous potential and resistivity

Map location number 2
LUFF 1-32 JANVRIN
API 40 063 20212
NE SE sec. 32, T. 23 N., R. 5 E.
Harding County, South Dakota
Kelly bushing elevation: 2,987 ft
Ground surface elevation: 2,974 ft
Log types shown: gamma ray, spontaneous potential, and resistivity

Map location number 3
BARRETT 11-33 STATE
API 40 063 20381
NW NW sec. 33, T. 22 N., R. 8 E.
Harding County, South Dakota
Kelly bushing elevation: 2,917 ft
Ground surface elevation: 2,905 ft
Log types shown: gamma ray and resistivity

Map location number 4
HUNT 1 GOVT
API 40 105 05066
NW SE sec. 8, T. 22 N., R. 11 E.
Perkins County, South Dakota
Kelly bushing elevation: 2,690 ft
Ground surface elevation: 2,678 ft
Log types shown: spontaneous potential and resistivity

Map location number 5
WEBB 3-2 SPENNY
API 40 105 20015
NW NE sec. 3, T. 22 N., R. 14 E.
Perkins County, South Dakota
Kelly bushing elevation: 2,501 ft
Ground surface elevation: 2,488 ft
Log types shown: gamma ray, spontaneous potential, and resistivity

Map location number 6
COCKRELL 16-1 STATE
API 40 031 20023
NW NW sec. 16, T. 21 N., R. 19 E.
Corson County, South Dakota
Kelly bushing elevation: 2,332 ft
Ground surface elevation: 2,321 ft
Log types shown: gamma ray and resistivity

Map location number 7
CHEVRON 13-5 BAILEY
API 40 031 20018
NW NE sec. 5, T. 21 N., R. 21 E.
Corson County, South Dakota
Kelly bushing elevation: 2,173 ft
Ground surface elevation: 2,162 ft
Log types shown: spontaneous potential and resistivity

Map location number 8
MURPHY 1 CAYMAN STATE A
API 40 031 20001
SW SW sec. 8, T. 21 N., R. 24 E.
Corson County, South Dakota
Kelly bushing elevation: 2,069 ft
Ground surface elevation: 2,058 ft
Log types shown: spontaneous potential, resistivity, and conductivity

Map location number 9
HOWARD SJOMLING
API 40 021 60049
NW NE sec. 3, T. 126 N., R. 78 W.
Campbell County, South Dakota
Ground surface elevation: 1,940 ft
Log types shown: gamma ray, spontaneous potential, and resistivity

Map location number 10
LEROY HOFFMAN
API 40 089 60077
NW SW sec. 33, T. 128 N., R. 70 W.
McPherson County, South Dakota
Ground surface elevation: 1,965 ft
Log types shown: spontaneous potential and resistivity

Map location number 11
OIL HUNTERS 1 RAETZMAN
API 40 013 05000
NE NE sec. 33, T. 125 N., R. 65 W.
Brown County, South Dakota
Kelly bushing elevation: 1,430 ft
Ground surface elevation: 1,423 ft
Log types shown: spontaneous potential and resistivity

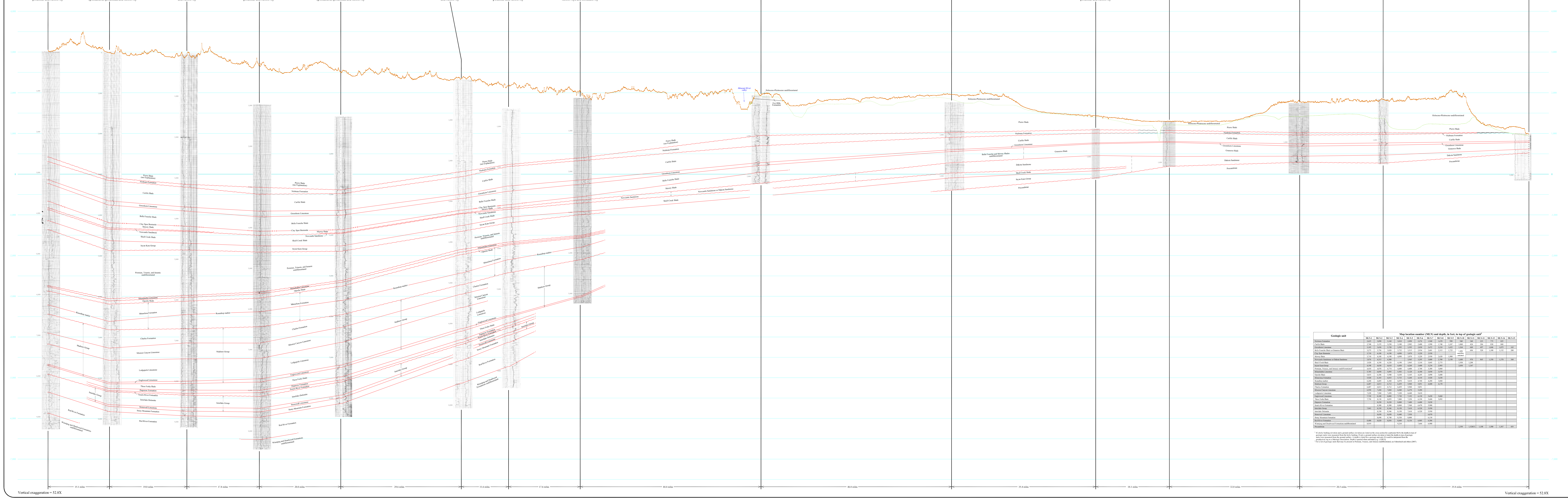
Map location number 12
ROBERT BERLIN
API 40 013 60063
SW sec. 7, T. 123 N., R. 62 W.
Brown County, South Dakota
Ground surface elevation: 1,300 ft
Log type shown: gamma ray

Map location number 13
AMAX-BRISTOL 1
API 40 037 60053
SW SW sec. 29, T. 122 N., R. 57 W.
Day County, South Dakota
Ground surface elevation: 1,790 ft
Log types shown: gamma ray, spontaneous potential, and resistivity

Map location number 14
PRIVATE WELL
API 40 091 60003
NE SW sec. 21, T. 125 N., R. 56 W.
Marshall County, South Dakota
Ground surface elevation: 1,840 ft
Log types shown: gamma ray, spontaneous potential, and resistivity

Map location number 15
CIRCLE K RESORT
API 40 109 60074
SW SE sec. 29, T. 126 N., R. 49 W.
Roberts County, South Dakota
Ground surface elevation: 980 ft
Log types shown: gamma ray, conductivity, and resistivity

A'



Geologic unit	Map location number (MLN) and depth, in feet, to top of geologic unit[1]														
	MLN-1	MLN-2	MLN-3	MLN-4	MLN-5	MLN-6	MLN-7	MLN-8	MLN-9	MLN-10	MLN-11	MLN-12	MLN-13	MLN-14	MLN-15
Niobrara Formation	2,625	3,090	3,160	3,010	2,890	2,276	1,940	1,670	990	940	340	223	775	825	
Carlile Shale	2,740	3,155	3,230	3,180	2,982	2,400	1,990	1,740	1,247	1,060	424	284	830	868	
Greenhorn Limestone	3,185	3,656	3,720	3,595	3,395	2,830	2,472	2,210	1,652	1,364	660	497	1,046	1,075	165
Belle Fourche Shale or Graneros Shale	3,275	3,756	3,820	3,732	3,515	2,934	2,601	2,315	1,725	1,406 undiffer-entiated	684	520	1,100	1,132	200
Clay Spur Bentonite	3,710	4,188	4,190	4,090	3,870	3,220	2,930								
Mowry Shale	3,710	4,188	4,190	4,090	3,870	3,220	2,930	2,620	1,900						
Newcastle Sandstone or Dakota Sandstone	3,876	4,315	4,300		3,945	3,295	3,000	2,700	2,150	1,680	970	865	1,350	1,370	360
Skull Creek Shale	3,920	4,350	4,320	4,190	3,965	3,310	3,045	2,775		1,930	1,288				
Inyan Kara Group	4,190	4,630	4,610	4,450	4,268	3,600	3,234	2,985		2,050	1,347				
Permian, Triassic, and Jurassic undifferentiated[2]	4,410	4,870	4,774	4,600	4,400	3,740	3,380	3,060							
Minnekahta Limestone	5,785	6,050	5,895	5,583	5,120	4,180	3,850	3,570							
Opeche Shale	5,815	6,106	5,940	5,630	5,165	4,245	3,890	3,600							
Minnelusa Formation	5,920	6,183	6,033	5,733	5,260	4,310	3,920	3,630							
Roundtop marker	6,260	6,605	6,360	6,070	5,610	4,760	4,280	3,860							
Madison Group	6,487	6,813	6,712	6,439	5,960	5,051	4,600	4,170							
Charles Formation	6,487	6,813	6,712	6,439	5,960	5,051									
Mission Canyon Limestone	6,950	7,260	7,060	6,840	6,270	5,280									
Lodgepole Limestone	7,220	7,560	7,450	7,220	6,640	5,610									
Englewood Limestone	7,720	8,100	8,000	7,720	7,192	6,130	5,650	5,060							
Three Forks Shale	7,750	8,138	8,059	7,800	7,250	6,190	5,680	5,092							
Duperow Formation		8,250	8,220	8,000	7,480	6,400	5,830								
Souris River Formation		8,300	8,300	8,060	7,560	6,470	5,900								
Interlake Group	7,963	8,330	8,346	8,150	7,610	6,520	5,950								
Interlake Dolomite		8,330	8,346	8,150	7,610	6,520	5,950								
Stonewall Limestone		8,650	8,650	8,440	7,930		6,070								
Stony Mountain Formation		8,690	8,740	8,530	8,000		6,130								
Red River Formation	8,400	8,820	8,856	8,660	8,136	6,905	6,306								
Winnipeg and Deadwood Formations undifferentiated	8,919			9,210		7,464	6,900								
Precambrian										2,350	1,520(?)	1,108	1,500	1,567	455

[1] If a kelly bushing elevation and a ground surface elevation are listed on the cross section for a particular MLN, the depths to tops of geologic units were measured from the kelly bushing. If only a ground surface elevation is listed, the depths to tops of geologic units were measured from the ground surface. A depth is listed for a geologic unit only if it could be interpreted from the geophysical log or a lithologic description. Depth is queried where uncertain [e.g. 1,520(?)].
[2] For a list of geologic units that may be present in Permian, Triassic, and Jurassic undifferentiated, see Fahrenbach and others (2007).

Vertical exaggeration = 52.8X

STATE OF SOUTH DAKOTA
M. Michael Rounds, Governor

DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
Steven M. Pirner, Secretary

DIVISION OF FINANCIAL AND TECHNICAL ASSISTANCE
David Templeton, Director

GEOLOGICAL SURVEY
Derric L. Iles, State Geologist

OIL AND GAS INVESTIGATION 2

Cross Sections Showing Geophysical Logs of Phanerozoic Rocks in South Dakota

Plate 1. Structural Cross Section A-A'

J.E. FOX, K.A. MCCORMICK, AND T.N. HAGGAR

2009

Prepared in cooperation with the Department of Geology and Geological Engineering, South Dakota School of Mines and Technology

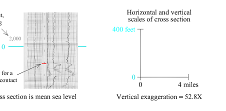
Explanation

The youngest geologic contact interpreted in areas west of the Missouri River is the contact between the Niobrara Formation and the Pierre Shale. It is recognized that younger geologic units often exist above the Pierre Shale, but they were not interpreted for this cross section.

- Correlation line at a conformable geologic contact. Interpreted from a geophysical log or lithologic description. Queried where uncertain
- Correlation line at a conformable geologic contact. Interpreted from Tomhave and Schulz (2004)
- Correlation line at an unconformable geologic contact. Interpreted from a geophysical log or lithologic description. Queried where uncertain
- Correlation line at an unconformable geologic contact. Interpreted from Tomhave and Schulz (2004)

Correlation lines are not intended to show detailed structure or actual elevation of a geologic unit between data points. Correlation lines are not projected to land surface near the Black Hills even though some geologic units crop out. The generalized nature of the cross section does not lend itself to illustration of these outcrop areas.

- Profile of land surface derived from U.S. Geological Survey digital elevation models
- Profile of the bedrock surface east of the Missouri River. Queried where uncertain. Due to the scale of the cross section, bedrock outcrop areas are not shown. Modified from Tomhave and Schulz (2004)
- × × × Bentonite bed
- Boundary of nomenclature change. Boundary shown in orange on index map below. Boundary and nomenclature generally coincide with Fahrenbach and others (2007)



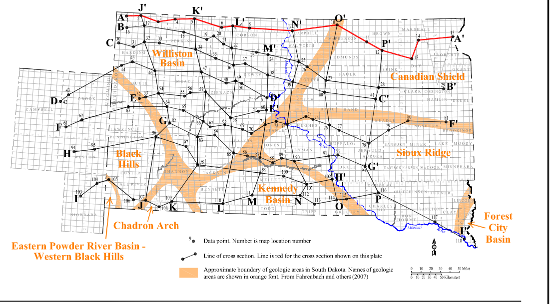
Datum for cross section is mean sea level

Horizontal and vertical scales of cross section

400 feet
0
0
4 miles

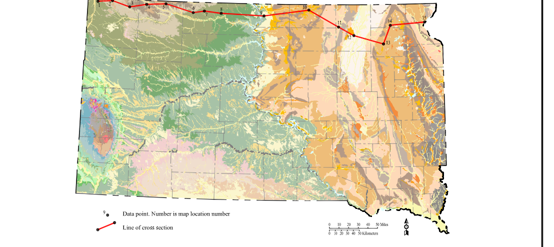
Vertical exaggeration = 52.8X

Index map showing locations of data points used for construction of cross sections



Index map showing surface geology along the line of cross section in South Dakota

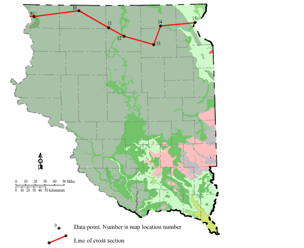
Modified from Martin and others (2004)



Map location number	Surface geologic unit	Bedrock geologic unit east of the Missouri River
1	Hell Creek Formation	
2	Hell Creek Formation	
3	Cannonball Formation	
4	Ludlow Formation	
5	Cannonball Formation	
6	Ludlow Formation	
7	Hell Creek Formation	
8	Hell Creek Formation	
9	Eolian deposits	Fox Hills Formation
10	Outwash, collapsed	Pierre Shale
11	Till, ground moraine	Pierre Shale
12	Lacustrine sediments	Pierre Shale
13	Till, stagnation moraine	Pierre Shale
14	Till, stagnation moraine	Pierre Shale
15	Lacustrine sediments	Carlile Shale

Index map showing bedrock geology along the line of cross section east of the Missouri River

Modified from Tomhave and Schulz (2004)



References

Fahrenbach, M.D., Steece, F.V., Sawyer, J.F., McCormick, K.A., McGillivray, G.L., Schulz, L.D., and Redden, J.A., 2007, *South Dakota stratigraphic correlation chart:* South Dakota Geological Survey Oil and Gas Investigation 1.

Martin, J.E., Sawyer, J.F., Fahrenbach, M.D., Tomhave, D.W., and Schulz, L.D., 2004, *Geologic map of South Dakota:* South Dakota Geological Survey General Map 10, scale 1:500,000.

Tomhave, D.W., and Schulz, L.D., 2004, *Bedrock geologic map showing configuration of the bedrock surface in South Dakota east of the Missouri River:* South Dakota Geological Survey General Map 9, scale 1:500,000.