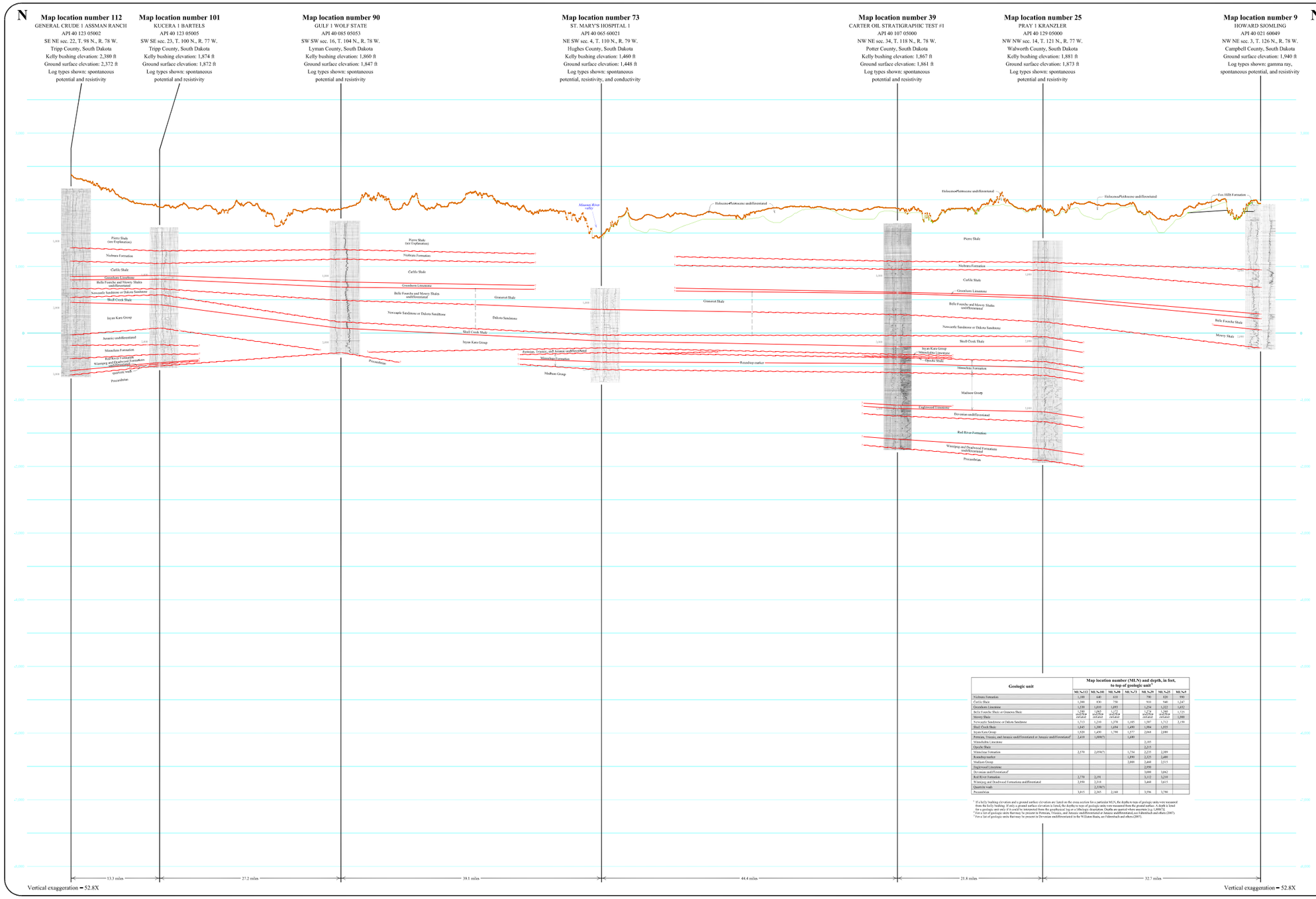

Geologic unit	Map location number (MLN) and depth, in feet, to top of geologic unit[1]						
	MLN 112	MLN 101	MLN 90	MLN 73	MLN 39	MLN 25	MLN 9
Niobrara formation	1,100	840	610		790	820	990
Carlile Shale	1,380	830	750		910	940	1,247
Greenhorn Limestone	1,530	1,010	1,093		1,254	1,222	1,652
Belle Fourche Shale or Graneros Shale	1,580 (at 1,670 m.s.l.)	1,063 (at 1,796 m.s.l.)	1,172 (at 1,676 m.s.l.)		1,274 (at 1,587 m.s.l.)	1,260 (at 1,613 m.s.l.)	1,721 (at 1,220 m.s.l.)
Mowry Shale							2,080
Newcastle Sandstone or Dakota Sandstone	1,713	1,230	1,370	1,105	1,587	1,712	2,150
Skull Creek Shale	1,845	1,380	1,494	1,490	1,984	1,855	
Inyan Kara Group	1,920	1,450	1,790	1,577	2,044	2,080	
Permian, Triassic, and Jurassic undifferentiated or Jurassic undifferentiated[2]	2,418	1,690[3]		1,680			
Minnelusha Limestone					2,185		
Opeche Shale					2,215		
Minnelusa Formation	2,570	2,010[3]		1,734	2,235	2,389	
Roundup marker				1,894	2,325	2,480	
Madison Group				2,088	2,440	2,515	
Englewood Limestone					2,880		
Devonian undifferentiated[4]					3,080	3,062	
Red River formation	2,770	2,191			3,112	3,210	
Winnipeg and Deadwood Formations undifferentiated	3,950	2,318			3,480	3,615	
Quartzite wash		2,330[3]					
Precambrian	3,015	2,365	2,140		3,596	3,740	

[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 in parentheses if it was not used to construct the cross section because it was measured on a different type of log than the other depths (e.g. LMN 112).
[2] For a geologic unit that may or may not be present in Permian, Triassic, and Jurassic undifferentiated or Jurassic undifferentiated, see Fahrenbach and others (2007).
[3] For a list of geologic units that may be present in Devonian undifferentiated in the Williston Basin, see Fahrenbach and others (2007).
[4] For a list of geologic units that may be present in Devonian undifferentiated in the Williston Basin, see Fahrenbach and others (2007).

STATE OF SOUTH DAKOTA
M. Michael Rounds, Governor

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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 14. Structural Cross Section N-N'

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

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 Fernbaye and Schulz (2004)
- Boundary of nomenclature change. Boundary shown in orange on index map below. Boundary and nomenclature generally coincide with Fahrenbach and others (2007)

Depth of well, in feet, below kelly bushing or ground surface

Mean sea level elevation in feet

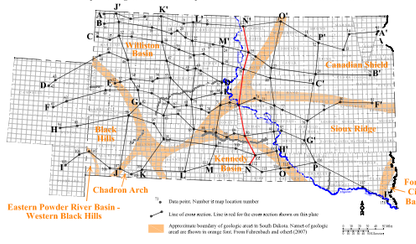
Marker for a geologic contact

Datum for cross section is mean sea level

Horizontal and vertical scales of cross section

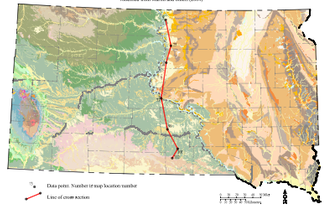
Vertical exaggeration = 52.8X

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

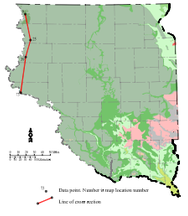
Modified from Martin and others (2004)



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

Modified from Fernbaye and Schulz (2004)

Map location number	Surface geologic unit	Bedrock geologic unit east of the Missouri River
112	Ogallala Group	
101	Pierre Shale	
90	Pierre Shale	
73	Orella, terrace	Pierre Shale
39	Colton diamicton	Pierre Shale
25	Till, pinnacles moraine	Pierre Shale
9	Colton diamicton	Fox Hills Formation



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Fahrenbach, M.D., Sawyer, J.F., Sawyer, J.F., McCormick, K.A., McGillivray, G.L., Schulz, L.D., and Robbins, 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.