GEOLOGIC MAP OF THE MARTIN 1° x 2° QUADRANGLE, SOUTH DAKOTA

Mark D. Fahrenbach, J. Foster Sawyer, and James E. Martin
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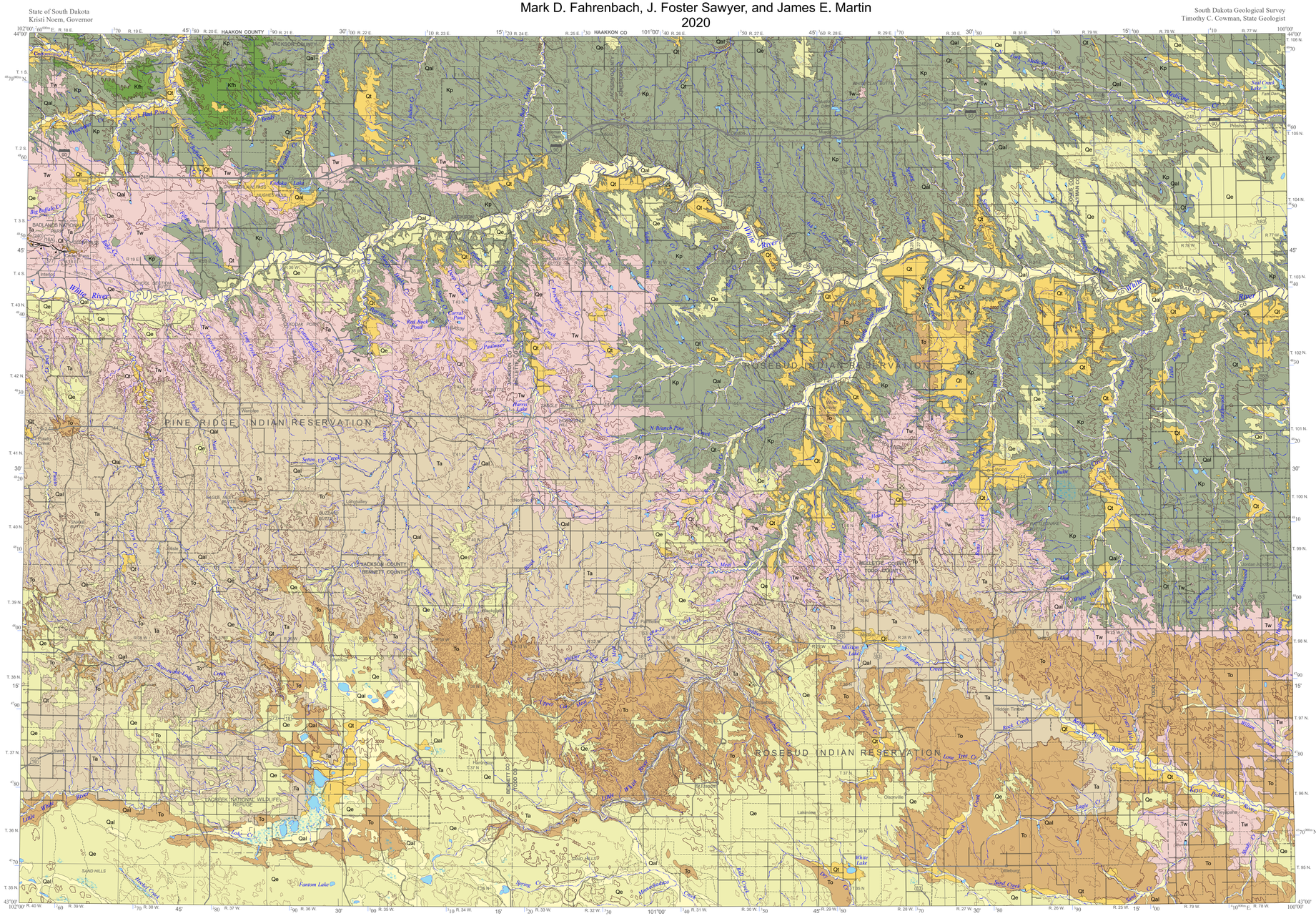
State of South Dakota
Kristi Noem, Governor

South Dakota Geological Survey
Timothy C. Cowman, State Geologist

SOUTH DAKOTA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF FINANCIAL AND TECHNICAL ASSISTANCE
GEOLOGICAL SURVEY PROGRAM
1° x 2° SERIES GEOLOGICAL QUADRANGLE MAP 2



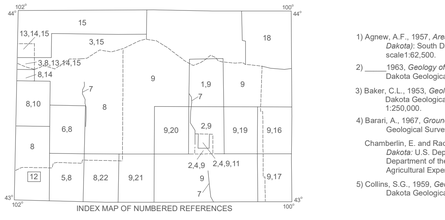
Map base digitized from U.S. Geological Survey 1:250,000 Martin quadrangle 1955 (Revised 1968) Digital Raster Graphic.
Road base modified from South Dakota Department of Transportation data.
Projection is Universal Transverse Mercator, Zone 14N.
Datum is 1983 North American.

The Geological Survey Program, Department of Environment and Natural Resources, engages in an ongoing data collection and interpretation process. An outcome of that process is to reflect those interpretations on maps such as this one. Reasonable efforts have been made to ensure that this map accurately reflects the source data used in its preparation. This map is date specific. As additional data become available, geological interpretations may be revised and the map may be updated by the Geological Survey. This map should not be relied upon as a regulatory product unless used in an attempt to interpret more detail than can be seen at the 1:250,000 scale.

SCALE 1:250,000

5 0 5 10 15 20 Miles
5 0 5 10 20 25 30 35 Kilometers

CONTOUR INTERVAL 100 FEET
WITH SUPPLEMENTARY CONTOURS AT 50 FOOT INTERVALS



INDEX MAP OF NUMBERED REFERENCES

Digital Cartography by Jonathan N. Luczak

UTM GRID AND 2020 MAGNETIC NORTH
DECLINATION AT CENTER OF MAP

QUADRANGLE LOCATION

CORRELATION OF MAP UNITS

Qal Qe Qt Ql			QUATERNARY
Unconformity			
To	Pliocene		
Disconformity			
	Miocene		TERTIARY
Ta			
Disconformity			
	Oligocene		
Tw	Eocene		
Disconformity			
Kfh	Upper Cretaceous		CRETACEOUS
Kp			

DESCRIPTION OF MAP UNITS

Qal **Alluvium** (Holocene-Pleistocene) - Clay- to boulder-size clasts, angular to rounded, unconsolidated to moderately consolidated, poorly- to well-sorted, and typically stratified. Derived from local bedrock and reworking of older surficial deposits. Deposited in stream valleys and on flood plains. Thickness up to 50 ft (15.2 m)

Qe **Eolian deposit** (Holocene-Pleistocene) - Very fine-grained calcareous silt to medium-grained quartz sand. Unconsolidated to moderately consolidated, angular to well-rounded, well-sorted, poorly- to well-stratified, and light yellowish-brown to tan. Quartz grains are clear to frosted. May contain minor amounts of dark minerals and feldspar grains. Much of the sand is derived from the Valentine Formation. Characterized by deflation topography with blowouts, and both active and dormant dunes and yardangs. Deposits are typically permeable and water bearing. Some blowouts have intersected the water table and contain small ponds. Local relief of dunes is over 160 ft (48.8 m). Loess forms a thin mantle over older deposits in many areas. Includes the Sand Hills Formation. Estimated thickness up to 200 ft (61.0 m)

Qt **Terrace deposit** (Holocene-Pleistocene) - Heterogeneous clay- to boulder-size clasts, unconsolidated to loosely consolidated, subangular to well-rounded, poorly- to well-sorted, typically stratified to cross bedded, and calcareous. The upper few feet usually contains a high silt and clay content. Sediments are from locally derived bedrock, reworking of Tertiary age gravels, and western-derived garnetiferous feldspathic quartzose sand and gravel of igneous rocks from the central Black Hills. Some deposits contain organic matter. Multiple terrace levels and ages may be included within a single mapped deposit. Some terraces occur up to 350 ft (106.7 m) above present drainages, but appear to have little relationship to them. Thickness up to 65 ft (19.8 m)

Ql **Landslide deposit** (Holocene-Pleistocene) - Coherent listric slumps and debris flows of randomly oriented, unconsolidated, poorly-sorted locally derived bedrock and soil. Typically developed on north- and east-facing slopes of the Pierre Shale, the Poleslide Member of the Brule Formation of the White River Group, and the Rockyford Ash Member of the Sharps Formation

Unconformity

To **Ogallala Group** (Pliocene-Miocene) - Fluvial sand, sandstone, gravel, and limestone deposited on a Miocene erosion surface having as much as 100 ft (30.5 m) of relief. Includes the undifferentiated Ft. Randall, Valentine, Ash Hollow, and Thin Elk formations, and the Medicine Root Gravel. Total thickness approximately 295 ft (89.9 m)

Medicine Root Gravel (Pliocene) - Heterogeneous clay- to boulder-size clasts, poorly-sorted, having a high percentage of igneous and less abundant metamorphic rocks derived from the central Black Hills. The gravel also contains clasts of most pre-Quaternary rocks and fossils found in southwestern South Dakota. Most of the fine fraction is locally derived material. The unit is typically not bedded, but some layers may show graded bedding. Deposition of the gravel was in the channel of the ancient "Medicine Root River," which had locally down cut more than 500 ft (152.4 m) into late Tertiary rocks. Fossils thought to be contemporaneous with deposition of the gravel suggest a possible Blancan age near the Pliocene-Pleistocene boundary. One deposit occurs east of the town of Potato Creek in T41N, R39W. Thickness up to 50 ft (15.2 m)

Disconformity

Thin Elk Formation (Pliocene) - Sand and gravel with minor amounts of volcanic ash, typically unconsolidated, and yellowish to brownish. Contains clasts of rock units from Precambrian to Miocene in age, including abundant quartz and feldspar from the Harney Peak Granite of the southern Black Hills, and large blocks of limestone locally eroded from the underlying Rosebud Formation. Concentrations of garnets are also common, with ledge-forming calcareously cemented garnetiferous lenses near the top of the formation. The Thin Elk has produced vertebrate fossils of the Early Pliocene (Clarendonian) Mission local fauna. The type section occurs in T40N, R28W. Thickness approximately 25 ft (7.6 m)

Disconformity

Ash Hollow Formation (Miocene) - Massive carbonate and silica cemented silt and fine- to medium-grained, subrounded, poorly to well-sorted, feldspathic quartz sandstone having abundant caliche veins and masses. White, light-gray, olive-gray, light-tan, to pinkish-white. Weathered surfaces are usually covered with dark-colored lichens and appear gray to dark-gray. Local box-work structures and recesses result from differential weathering. White, dense, gritty, discontinuous ashy siltstone and limestone beds 0.5-1.5 ft (0.15-0.46 m) thick occur locally at the base. The limestone weathers brilliant white and contains black dendrites and gastropod fossils, and locally has beds of soft, flaky, grayish-white diatomaceous earth. The Ash Hollow Formation contains *Celtis willistoni* seeds and abundant silicified and calcified plant roots and stems. The lower contact with the Valentine Formation is placed at the base of the lowest cemented sand or limestone bed. Beds of volcanic ash as much as 11 ft (3.4 m) thick occur locally near the top of the Ash Hollow Formation. The formation was previously referred to as the "mortar beds," which included the "cap rock bed" that erodes to form low, prominent bluffs. Includes the "Bijou quartzite facies." The Ash Hollow Formation typically forms rounded caps of hills and ledges, and is more resistant to weathering than the Valentine Formation. Thickness approximately 10-180 ft (3.0-54.9 m)

Disconformity

Valentine Formation (Miocene) - Feldspathic quartz sandstone and siltstone with interbedded greenish calcareous claystone and bentonitic clay. Unconsolidated to loosely consolidated, noncalcareous to calcareous, very fine- to medium-grained, thick-bedded, and locally cross bedded. Greenish-gray, light-gray, olive-gray, to tan. Sand grains are poorly- to well-sorted, subangular to well-rounded, with some being frosted. Contains carbonate and silica replaced root and stem casts, and petrified wood. Garnetiferous, quartzose, and feldspathic, very coarse-grained sand and gravel, and local calcium carbonate cemented sand lenses occur at the base. Gravel clasts are well-rounded quartz, feldspar, and igneous rocks derived from the Black Hills and may occur up to 20 ft (6.1 m) above the base of the formation. The lower Valentine Formation has light-gray to reddish-brown, fine- to medium-grained feldspathic sand with thin layers of greenish bentonitic clay. Calcareous concretions to 3 ft (0.9 m) across occur near the base and top of the formation. Unconsolidated ashy beds and olive-green silicified clayey siltstone beds capped by a thin layer having small, white concretions are present at the top. The Valentine Formation includes the 38-54 ft (11.6-16.5 m) thick "Bijou quartzite facies" of hard, green, medium- to fine-grained, silica-cemented cross bedded sandstone and conglomerate that occurs locally at various stratigraphic levels within the Valentine and into the Ash Hollow Formation. Forms a resistant caprock. Light-green silicified clay balls, bentonitic clay, or hard, calcareously cemented zones occur locally at the base of the "Bijou quartzite facies." Interbedded within silicified beds are lenses of clayey, medium- to fine-grained, unconsolidated feldspathic quartz sand. The upper contact of the Valentine Formation is placed above a thin, brownish limestone that weathers bright white and contains large gastropod fossils. The Valentine Formation typically weathers to smooth, permeable, sandy slopes with small blowouts in sandy areas, and supplies sand for the eolian Sand Hills Formation. Thickness variable from 30-200 ft (9.1-61.0 m) due to downcutting and deposition in a Miocene age topographic low

Disconformity

Ft. Randall Formation (Miocene) - Claystone, and ashy or sandy claystone and siltstone, thin- to thick-bedded, pink, reddish-brown, and gray, becoming light-green toward the top. Interbedded with gray, pink, to greenish, medium- to thick-bedded sandstone and silty sandstone. Sands are poorly to very consolidated, very fine- to fine-grained, and bedded to cross bedded. The upper half of the Ft. Randall Formation contains several beds of tan to white, hard calcareous concretions. A bed containing late Barstovian age fossils occurs approximately 43 ft (13.1 m) above the base of the formation. Typically weathers to steep, crumbly slopes. Thickness approximately 60-120 (18.3-36.6 m)

Ta **Arikaree Group** (Miocene-Oligocene) - Includes the undifferentiated Sharps, Monroe Creek, Harrison, Rosebud, and Batesland formations. Units become less distinct from west to east in the quadrangle, and generally thicken to the south. Combined thickness approximately 175-350 ft (53.3-106.7 m)

Disconformity

Batesland Formation (Miocene) - Interbedded medium- to thick-bedded ashy siltstone, calcareous siltstone, marl, claystone, silty to sandy claystone, and very fine- to coarse-grained, poorly consolidated, bedded to cross bedded channel sandstones. Light-green, gray, to pink. Some beds are gradational vertically and horizontally. Concretionary beds are typically absent. Mineralized root casts are present in some beds. Deposited as a paleo-valley fill with channels having eroded into the underlying Rosebud Formation. Contains Hemingfordian age fossils. Thickness approximately 50 ft (15.2 m)

Disconformity

Rosebud Formation (Miocene) - Sandstone and clayey silt with shards of volcanic glass, very fine-grained, and poorly cemented. Interbedded with calcareous sand, silicified claystone, and clay, light-tan, brown, to pink. Also contains thin interbedded limestone beds, gray to pinkish-gray tabular concretions, and small light-brown and greenish clay balls. Many small tubular holes of paleo-root casts are present. Similar in appearance to the Brule Formation. Easily erodible by wind, forming rolling hills. The fauna of the Rosebud Formation on the Rosebud Reservation is early Arikareean, but has a late Arikareean fauna in the Wounded Knee area on the Pine Ridge Reservation west of the Martin quadrangle. Therefore, the Rosebud Formation may be laterally equivalent to the Sharps through Rosebud formations. Thickness as much as 295 ft (89.9 m)

Disconformity

Harrison Formation (Miocene) - Lower portion is very fine-grained sand and silt, thick-bedded, non-calcareous, poorly cemented, and light-pink to brown. Contains discontinuous calcareous concretionary layers that form thin, continuous ledges from 3-10 ft (0.9-3.0 m) apart. The upper portion of the formation becomes less uniform in composition and is mainly grayish to tan, generally calcareous, poorly cemented fine sand and silt having discontinuous lenses of platy white sandy limestone or limy sandstone. Many isolated, nodular concretions are disseminated throughout the less cemented sandstones. The upper Harrison Formation has many coarse sandy to conglomeratic channel deposits of varying thickness and composition interbedded with light-yellowish gray to medium-gray lenticular beds of soft, calcareous, caliche-cemented sandstone. These upper channel deposits may be correlative with the Ogallala Group, but are lithologically indistinguishable from sands lower in the Harrison Formation, so their stratigraphic correlation is uncertain. The base of the Harrison is generally placed at the lowest thin concretionary zone that weather grayish-white to brilliant white, or the lowest thinly laminated calcareous siltstone. Post-Miocene erosion has locally down cut through the Harrison to the Monroe Creek Formation. The Harrison Formation forms steep slopes with small ledges, and gently undulating hills with well- to poorly-defined mesas and escarpments. Thickness approximately 15-164 ft (4.6-50.0 m)

Disconformity

Monroe Creek Formation (Oligocene) - Siltstone, poorly to well consolidated, pink, pinkish-brown to tan, and grayish to light-tan, very fine-grained, well-sorted, non-calcareous, thick-bedded sandstone. Locally with uncemented volcanic ash beds and elongate, vertical concretions. The Monroe Creek Formation is quite uniform in composition with little lithologic variation. Contains *Celtis willistoni* seeds. Includes the Gering and Mellette facies. The Gering facies occurs at the base of the Monroe Creek Formation and is as much as 70 ft (21.3 m) thick. It consists of gray, very fine- to coarse-grained, cross bedded feldspathic channel sandstones and conglomerates of limestone and sandstone fragments associated with rounded to lenticular limestone concretions that weather by exfoliation. Clay content, limestone concretions, and pinkish-gray sandstone beds increase in abundance upward. The Mellette facies occurs approximately 150 ft (45.7 m) above the base of the formation and consists of several layers of creamy-white, flaggy, dense limestone beds or lenses up to 4 ft (1.2 m) thick interbedded with pinkish-gray, very fine-grained sandstone. The limestone beds contain calcite veins, black manganese oxide dendrites, silica nodules, abundant calcite- and silica-replaced gastropod fossils, and weathers brilliant white. The lower contact of the Monroe Creek Formation may be delineated by an erosional escarpment above the Sharps Formation. The upper contact is erosional and difficult to locate precisely. Moderately resistant to erosion, forming cliffs along stream valleys, and smooth, hummocky topography without flat-topped hills in upland areas. Exposures are characteristically rounded and have areas of black lichen. Estimated thickness 90-250 ft (27.4-76.2 m)

Disconformity

Sharps Formation (Oligocene) - Silt to very fine-grained feldspathic sandstone, thick-bedded, poorly consolidated, pinkish-tan. Contains small, gray, calcareous concretions, local lenses of freshwater limestone, clastic dikes, and chalcedony veinlets. Fine-grained clayey sandstones contain ellipsoidal calcareous nodules up to 5 in (12.7 cm) across that are typically separated by several inches to feet, and become less abundant upward. Locally with channels of coarse-grained sand and gravel that were eroded as much as 62.3 ft (19.0 m) into the Brule Formation. The basal unit of the Sharps Formation is the Rockyford Ash Member, a columnar jointed, white, silty, zeolitic volcanic ash as much as 49 ft (14.9 m) thick. The top of the Sharps Formation is marked by about 12 ft (3.7 m) of very fine-grained gray to pinkish-gray sandstone having numerous pockets and thin seams of pink clay in the lower portion. The upper portion is cemented with calcite and is a prominent ledge former locally capped by 0.5-2 in (1.3-5.1 cm) of noncalcareous pink clay. The Sharps Formation is similar in appearance to the underlying Brule Formation but has more of a brownish color than the Brule. The elongated concretions, a higher calcareous and clay content, and gently rolling topography help differentiate it from the Monroe Creek Formation. Thickness approximately 153-328 ft (46.6-100.0 m)

Tw **White River Group** (Oligocene-Eocene) - Includes the undifferentiated Chadron and Brule formations. Total thickness as much as 602 ft (183.5 m)

Disconformity

Brule Formation (Oligocene) - Interbedded clay, silt, sand, and volcanic ash, pinkish-gray, greenish-gray, and yellowish-gray. Contains channel sandstones, clastic dikes, and chalcedony veinlets. Sandstones decrease in abundance toward the top of the formation. Includes distinct lower and upper "nodular layers" of calcareous concretions. The lower approximately 110-115 ft (33.5-35.1 m) of the formation corresponds to the Scenic Member and typically has alternating horizontal banding of pinkish to reddish bentonitic siltstone and grayish to white siltstone and sandstone that form resistant ledges. The upper approximately 70-80 ft (21.3-24.4 m) of the formation corresponds to the Poleslide Member, and is dominantly orange, brown, olive, to white banded bentonitic clay and siltstone having root casts. Sand content increases upward. The Brule Formation weathers to very steep slopes and knife-edge ridges. Contains Whitneyan and Orellan age fossils. Thickness as much as 492.2 ft (150.0 m)

Disconformity

Chadron Formation (Eocene) - Silty bentonitic clay and claystone, gray, pale gray-green, greenish-yellow, and olive-gray to pink, alternating with greenish-gray siltstone and cross bedded channel sands and gravels. Sands are very fine- to coarse-grained, subangular to well-rounded, with some silica cement. A thin, discontinuous, basal, fine- to coarse-grained sandstone to poorly cemented gravel up to 10 ft (3.0 m) thick containing balls of limonite-cemented sand grains and interbedded layers of rounded quartz, feldspar, and chert clasts to several inches across occurs locally. Thin, yellowish-gray, silty freshwater algal limestone beds and carbonate concretions occur locally near the gradational contact with the Brule Formation where the color changes from greenish-gray of the Chadron Formation to the pinkish-gray of the Brule Formation. Weathers to low, grayish, rounded "haystack mounds" typically having a cracked, popcorn-like surface. Contains Chadronian age fossils. Includes the Crazy Johnson and Peanut Peak members. Thickness as much as 180 ft (54.9 m)

Disconformity

Kfh **Fox Hills Sandstone** (Upper Cretaceous) - Sandstone, very fine- to coarse-grained, thin-bedded and platy, gray. Interbedded with gray, green, and brown clay, shale, and silty shale. Contains gray to brown sandy concretions several feet in diameter. Locally cemented and concretionary, medium- to thick-bedded, cross bedded sandstones occur at the top of the formation. Exposed thickness up to 100 ft (30.5 m)

Kp **Pierre Shale** (Upper Cretaceous) - Individual members were not identified, so here divided into undifferentiated lower and upper units. Total thickness of the Pierre Shale from well logs is approximately 900-1200 ft (274.3-365.7 m)

Pierre Shale upper unit - Bentonitic and marly calcareous shale, dark-gray to black with white speckles, and approximately 80 ft (24.4 m) thick. Overlain by 130-150 ft (39.6-45.7 m) of light-gray, olive-tan, brown to black, calcareous to non-calcareous shale and silty shale, blocky at the base to thin-bedded near the top, and weathering to yellowish-brown. Gypsum, ilmonite, and iron sulfate minerals are present along fractures, bentonite layers, and bedding planes. Thin, white, light-gray to yellowish-brown septarian limestone concretions occur at the top of the unit. Prone to landslides, slumps, and earth flows, especially on steep north- and east-facing slopes. Thickness of the Pierre Shale upper unit is approximately 185-270 ft (56.4-82.3 m). The Tertiary age Interior Paleosol, a local 10-40 ft (3.0-12.2 m) thick yellow-brown to purple weathered zone having up to 30 ft (9.1 m) of erosional relief, is disconformably developed on top of the Pierre Shale upper unit

Pierre Shale lower unit - Bentonitic shale, calcareous, blocky to platy, gray, medium-gray, to black, and over 195 ft (59.4 m) thick. Weathers into thin, light-gray flakes. Overlain by 90 ft (27.4 m) of gray to dark-gray calcareous shale containing selenite crystals. Several layers of gray, lenticular limestone concretions to several feet in diameter containing *Baculites* sp., pelecypods, and gastropods occur at the top of the Pierre Shale lower unit. Prone to landslides, slumps, and earth flows, especially on steep north- and east-facing slopes. Exposed thickness of the Pierre Shale lower unit is over 285 ft (86.9 m)

CONTACT

FAULT

Bar and ball on downthrown side

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