

Geologic Map of the Deadwood North Quadrangle, South Dakota

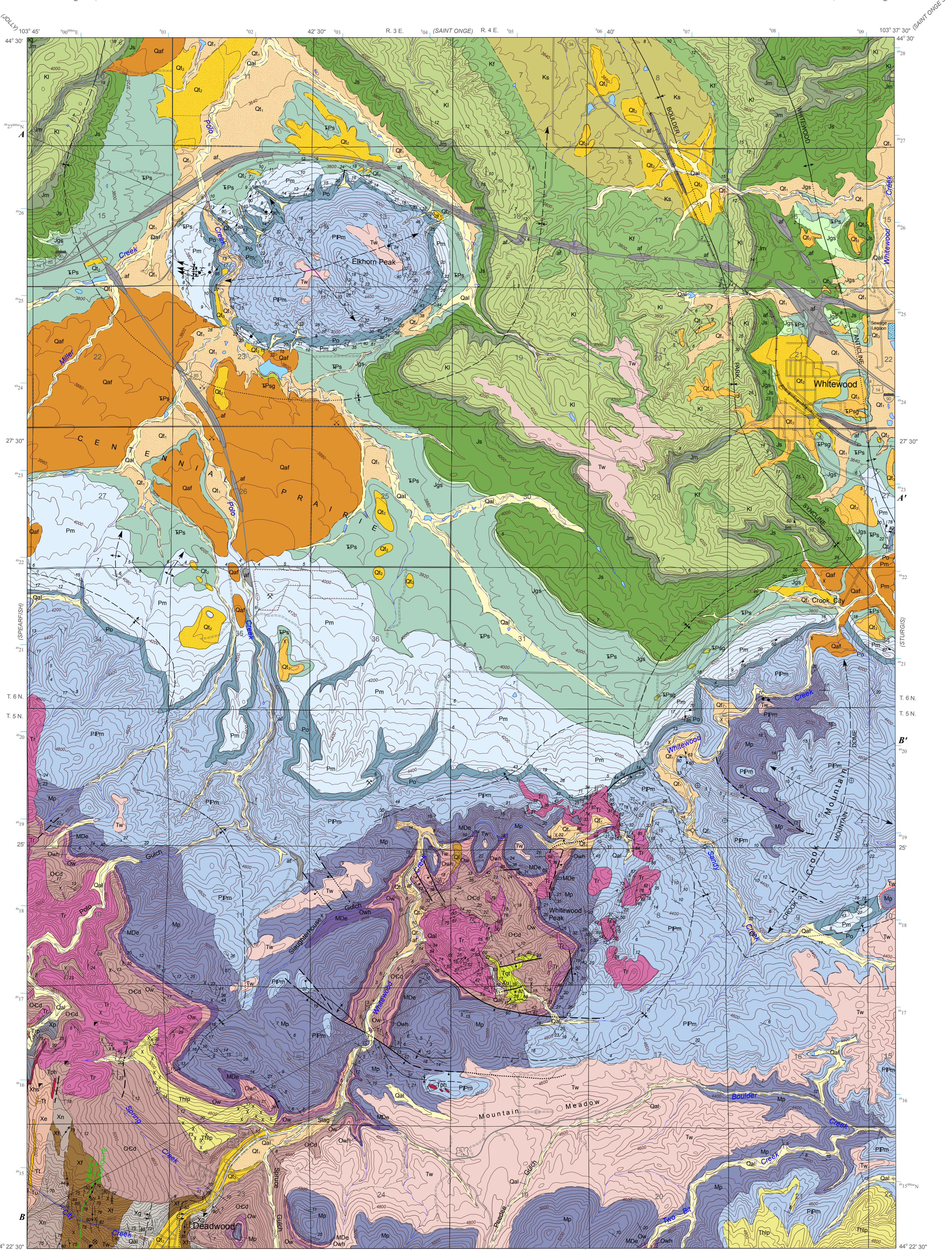
Alvis L. Lisenbee¹, Jack A. Redden¹, and Mark D. Fahrenbach
2015

South Dakota Geological Survey
Derrick L. Iles, State Geologist

State of South Dakota
Dennis Daugaard, Governor



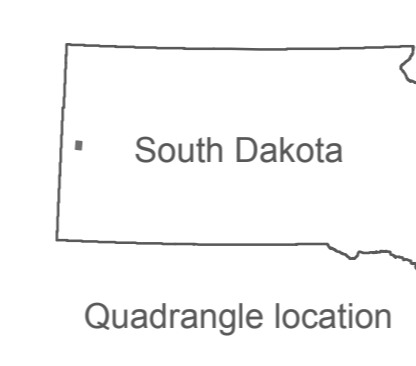
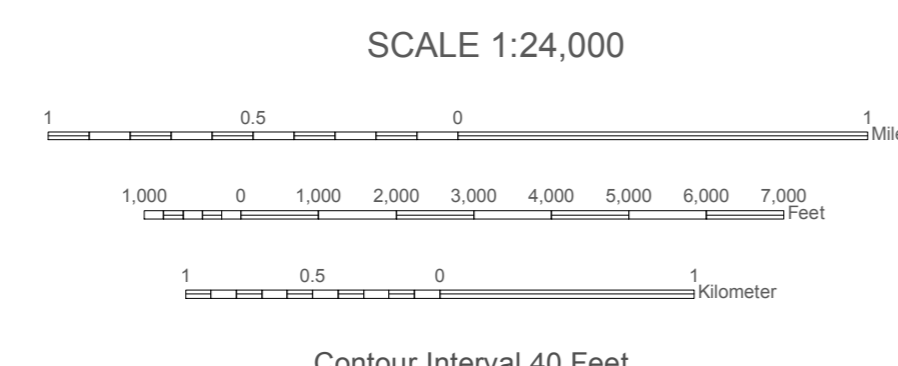
Prepared in cooperation with the South Dakota School of Mines and Technology, Rapid City, South Dakota



Edited by Mark D. Fahrenbach
Digital Cartography by Mark D. Fahrenbach and Wesley P. Christensen
Geologic mapping assistant July-August, 2012: Morgan Summers¹

Map base modified from U.S. Geological Survey 1:24,000-scale Deadwood North digital line graph.
Projection is Universal Transverse Mercator, Zone 13N.
Datum is 1983 North American.
UTM grid information generated from the ArcMap™ layout grid function.

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. As additional data become available, geologic interpretations may be revised and the map may be updated by the Geological Survey Program. This map should not be enlarged or otherwise used in an attempt to interpret more detail than can be seen at a scale of 1:24,000.



Index to sources of geologic data

(letters correspond to those listed in Selected References)

- Selected References**
- a) Beck, Jr., J.A., 1976. *Geology of the Lexington Hill-Pillar Peak area, Lawrence County, South Dakota*. Rapid City, S. Dak., South Dakota School of Mines and Technology, M.S. thesis, 102 p.
 - b) Boyd, T.M., 1975. *Bedrock geology of the Whitewood Peak area, Lawrence County, South Dakota*. Toledo, Ohio, University of Toledo, M.S. thesis, 89 p.
 - c) Caddey, S.W., Bachman, R.L., Campbell, T.J., Reid, R.R., and Otto, R.P., 1991. *The Homestake gold mine, an Early Proterozoic iron-formation-hosted gold deposit, Lawrence County, South Dakota*. U.S. Geological Survey Bulletin 1557-A, p. 1-67.
 - d) Getz, R.C., 1966. *Joining and stratigraphy on Elk Horn Peak, Whitewood, South Dakota and Green Mountain, Sundance, Wyoming*. Rapid City, S. Dak., South Dakota School of Mines and Technology, M.S. thesis, 70 p.
 - e) Hadji-Sabagah, M., 1979. *Structural geology of the Crook Mountain and Whitewood area, Lawrence-Meadow counties, South Dakota*. Rapid City, S. Dak., South Dakota School of Mines and Technology, M.S. thesis, 58 p.
 - f) McDowell, F.W., 1971. *K-Ar ages of igneous rocks from the western United States*. *Isotropy*, v. 2, p. 1-16.
 - g) Mukherjee, N.S., 1956. *Geology and mineral deposits of the Galena-Gilt Edge area, northern Black Hills, South Dakota*. Golden, Col., Colorado School of Mines, Ph.D. dissertation, 288 p.
 - h) Plumley, W.J., 1948. *Black Hills terrace gravels: a study in sediment transport*. *Journal of Geology*, v. 56, p. 526-577.
 - i) Redden, J.A., Peterman, Z.E., Zartman, R.E., and DeWitt, E., 1990. *U-Th-Pb geochronology and preliminary interpretation of Precambrian tectonic events in the Black Hills, South Dakota*. In Lewry, J.F., and Stauffer, M.R., eds., *The Early Proterozoic Trans-Hudson orogen of North America*, Geological Association of Canada, Special Paper 37, p. 229-251.
 - j) Slaughter, A.L., 1968. *Homestake Mine*. *Wyoming Geological Association, 20th Annual Field Conference Guidebook to the Black Hills area, South Dakota, Montana, and Wyoming*, p. 157-172.
 - k) South Dakota Department of Environment and Natural Resources. *Water Well Completion Reports*. <http://dnr.sd.gov/wr/dtlogsearch.aspx>

EXPLANATION

| | | | | | | | | | | | | | | | | | | | | | | | | |
|----------------------|------------|---|------------|---|------------|--|------------|--|------------|---|------------|--|------------|--|-----------|---|-----------|---|------------|---|-----------|---|------------|---|
| Quaternary | Qal | Alluvium - Unconsolidated to loosely consolidated; clasts to boulder-size. Deposited in present-day stream drainages. Estimated maximum thickness 35 ft (10.7 m) | Q1 | Terrace deposit 1 - Unconsolidated to loosely consolidated; clasts to boulder size. Deposited up to 15 ft (4.6 m) above present-day stream drainages. Maximum thickness of 90 ft (27.4 m) reported from well logs | Q2 | Terrace deposit 2 - Unconsolidated to loosely consolidated; clasts to boulder size. Deposited approximately 40-60 ft (12.2-18.3 m) above present-day stream drainages. Estimated maximum thickness 20 ft (6.1 m) | Q3 | Terrace deposit 3 - Unconsolidated to loosely consolidated; clasts to boulder size. Deposited approximately 120-360 ft (36.6-109.7 m) above present-day stream drainages. Estimated maximum thickness 60 ft (18.3 m) | Qaf | Alluvial fan deposit - Unconsolidated to loosely consolidated; clasts to boulder size. Locally derived; deposited at mouths of drainages. Estimated maximum thickness 30 ft (9.1 m) | | | | | | | | | | | | | | |
| Oligocene | Tw | White River Group - Unconsolidated to moderately consolidated. Clasts to boulder size; dominantly of Precambrian rock types with Paleozoic sedimentary and Tertiary igneous rocks. Fine grained matrix and bentonitic clay content variable. The deposit at Mountain Meadow is equivalent to the Mountain Meadow terrace of Plumley (1948). Maximum thickness of 240 ft (73.1 m) reported from well completion reports | Ph | Phonolite - Light to medium-greenish gray to gray; weathering dark-brown. Aphanitic groundmass of plagioclase and orthoclase with 5% subhedral to anhedral grains of nepheline to 0.12 in (3 mm) across. Contains 10% euhedral to subhedral phenocrysts of oligoclase-andesine up to 0.31 in (8 mm) across that have Carlsbad and abite twinning and are commonly zoned, and 35-40% subhedral to elongate, euhedral to anhedral, phenocrysts of pyroxene up to 0.21 in (5 mm) long that have euhedral cores surrounded by aggrine; some are twinned. Accessory minerals include hornblende, 1-2% wedge-shaped crystals of titanite, up to 1% apatite needles associated with feldspars, as much as 2% anhedral magnetite that commonly encloses aggrine-augite and hornblende phenocrysts. Feldspar matrix locally altered to sericite, locally replaced by zoisite, and aggrine-augite and hornblende replaced by chlorite. Massive, well jointed; weathers to small angular fragments (Boyd, 1975) | Tr | Rhyolite - White to light-gray, locally with thin violet to beige banding. Aphanitic groundmass of albite, orthoclase, and quartz contains 2% subhedral to euhedral albite phenocrysts 0.04-0.2 in (1-5 mm) long. Most are twinned but rarely zoned. Many of the feldspars have been altered to sericite with minor carbonate. 2-3% biotite flakes are present and aligned parallel to flow layering. Small magnetite grains occur as an accessory. Iron oxide and dendritic manganese oxide occurs on fracture surfaces. Massive at the center of intrusion, with flow layering occurring at margins. Contacts typically have 0.04-0.16 in (1-4 mm) thick fissile partings. Weathers to an angular, blocky to flakey appearance (Beck, 1976). Has a K-Ar date of 60.5 ± 3 m.y. (Mukherjee, 1956) | Thp | Hornblende latite porphyry - Light gray to dark-greenish-gray. Aphanitic to glassy groundmass of orthoclase with up to 3% quartz contains 40% euhedral plagioclase phenocrysts, 1-10% aligned hornblende, and 1-5% sandine up to 0.2 in (5 mm) across. Locally contains actinolite and quartz-filled amygdaloids up to 0.16 in (4 mm) across. Contains trace pyroxene, magnetite, ilmenite, pyrite, and calcite. Local propylitic alteration (Beck, 1976). Has a K-Ar date of 60.5 ± 3 m.y. (Mukherjee, 1956) | Tqt | Quartz trachyte - Pink to pinkish-brown with diffuse banding, weathering to beige or greenish hues. Aphanitic groundmass of equifugal plagioclase and orthoclase with lesser granular quartz contains 25-30% subhedral to euhedral albite phenocrysts up to 0.16 in (4 mm) across that are aligned with layering; some have Carlsbad twinning. Feldspars may be sericitized, altered to clay in the center, or are preserved as molds filled with clay or iron oxide. Masses of magnetite and iron oxide aligned with banding make up 2-3% of the groundmass. Secondary carbonate and fluorite occur as void fillings. Contains stringers of pyrite. Uniformly massive with poorly developed jointing. Weathers to small rounded boulders (Boyd, 1975) | Tp | Feldspar porphyry - Shows only in cross section | Tu | Tertiary igneous rocks (undifferentiated) - Leucocratic to mesocratic, aphanitic to porphyritic, hypabyssal intrusive rocks. Includes phonolitic, rhyolitic, trachytic, and latitic rocks | | | | | | | | | | |
| Tertiary | Ks | Skull Creek Shale - Dark-gray to black fissile shale. Contains sparse ferruginous concretions. Minor fine-grained sandstone and bentonite at the base. Weathers easily to form a grass-covered slope. Exposed thickness approximately 9-120 ft (0.3-36.6 m) | Kf | Fall River Formation - Variegated yellowish-orange, reddish-brown, tan to white, fine-grained quartz arenite and brown to light-gray mudstone, siltstone, and carbonaceous beds. Thin- to medium-bedded. Thickness approximately 100-150 ft (30.5-45.7 m) | Kl | Lakota Formation - Yellowish-orange, tan to white, fine-grained quartz arenite and brown to light-gray mudstone and siltstone. Thin- to medium-bedded, locally with abundant cross bedding. Formation is poorly exposed. Thickness approximately 250 ft (76.2 m) | Mp | Morrison Formation - Variegated gray, green, to maroon bentonitic claystone, siltstone, and sandstone with minor limestone. Weathers with a popcorn-like appearance. Typically forms a grass-covered slope. Thickness approximately 40-140 ft (12.2-42.7 m) | Jb | Sundance Formation - Includes the following members which were observed in the field but not differentiated on the map or cross section. Formation is poorly exposed. Thickness approximately 250-285 ft (76.2-86.9 m) | Jm | Redwater Shale Member - Greenish-gray to olive-green glauconitic shale, siltstone, and minor sandstone. Laminated to thin-bedded. Fine- to very fine-grained; calcareous. Contains the fossil belemnite <i>Pachyteuthis</i> sp. Thickness 40-50 ft (12.2-15.2 m) | Jp | LAK Member - Reddish-brown to brownish-orange, massive to poorly bedded siltstone and fine-grained sandstone. Thickness approximately 50-80 ft (15.2-24.4 m) | Jh | Hulet Sandstone Member - Tan to yellowish-orange, fine-grained, thin-bedded quartz arenite having thin shaly interbeds. Contains abundant ripple marks and trace fossils. Thickness approximately 40-50 ft (12.2-15.2 m) | Jb | Stockade Beaver Shale Member - Greenish-gray to olive green glauconitic shale, siltstone, and minor sandstone. Laminated to thin-bedded. Fine- to very fine-grained; calcareous. Contains the fossil belemnite <i>Pachyteuthis</i> sp. Thickness approximately 30-40 ft (9.1-12.2 m) | Jgs | Gypsum Spring Formation - Massive white to light-gray gypsum with thin interbedded reddish siltstone and shale. Thickness 35-40 ft (10.7-12.2 m) | | | | |
| Cretaceous | Jm | Morrison Formation - Variegated gray, green, to maroon bentonitic claystone, siltstone, and sandstone with minor limestone. Weathers with a popcorn-like appearance. Typically forms a grass-covered slope. Thickness approximately 40-140 ft (12.2-42.7 m) | Jb | Sundance Formation - Includes the following members which were observed in the field but not differentiated on the map or cross section. Formation is poorly exposed. Thickness approximately 250-285 ft (76.2-86.9 m) | Jm | Redwater Shale Member - Greenish-gray to olive-green glauconitic shale, siltstone, and minor sandstone. Laminated to thin-bedded. Fine- to very fine-grained; calcareous. Contains the fossil belemnite <i>Pachyteuthis</i> sp. Thickness 40-50 ft (12.2-15.2 m) | Jp | LAK Member - Reddish-brown to brownish-orange, massive to poorly bedded siltstone and fine-grained sandstone. Thickness approximately 50-80 ft (15.2-24.4 m) | Jh | Hulet Sandstone Member - Tan to yellowish-orange, fine-grained, thin-bedded quartz arenite having thin shaly interbeds. Contains abundant ripple marks and trace fossils. Thickness approximately 40-50 ft (12.2-15.2 m) | Jb | Stockade Beaver Shale Member - Greenish-gray to olive green glauconitic shale, siltstone, and minor sandstone. Laminated to thin-bedded. Fine- to very fine-grained; calcareous. Contains the fossil belemnite <i>Pachyteuthis</i> sp. Thickness approximately 30-40 ft (9.1-12.2 m) | Jgs | Gypsum Spring Formation - Massive white to light-gray gypsum with thin interbedded reddish siltstone and shale. Thickness 35-40 ft (10.7-12.2 m) | | | | | | | | | | |
| Jurassic | Tp | Feldspar porphyry - Shows only in cross section | Tu | Tertiary igneous rocks (undifferentiated) - Leucocratic to mesocratic, aphanitic to porphyritic, hypabyssal intrusive rocks. Includes phonolitic, rhyolitic, trachytic, and latitic rocks | Ks | Skull Creek Shale - Dark-gray to black fissile shale. Contains sparse ferruginous concretions. Minor fine-grained sandstone and bentonite at the base. Weathers easily to form a grass-covered slope. Exposed thickness approximately 9-120 ft (0.3-36.6 m) | Kf | Fall River Formation - Variegated yellowish-orange, reddish-brown, tan to white, fine-grained quartz arenite and brown to light-gray mudstone, siltstone, and carbonaceous beds. Thin- to medium-bedded. Thickness approximately 100-150 ft (30.5-45.7 m) | Kl | Lakota Formation - Yellowish-orange, tan to white, fine-grained quartz arenite and brown to light-gray mudstone and siltstone. Thin- to medium-bedded, locally with abundant cross bedding. Formation is poorly exposed. Thickness approximately 250 ft (76.2 m) | Mp | Morrison Formation - Variegated gray, green, to maroon bentonitic claystone, siltstone, and sandstone with minor limestone. Weathers with a popcorn-like appearance. Typically forms a grass-covered slope. Thickness approximately 40-140 ft (12.2-42.7 m) | Jb | Sundance Formation - Includes the following members which were observed in the field but not differentiated on the map or cross section. Formation is poorly exposed. Thickness approximately 250-285 ft (76.2-86.9 m) | Jm | Redwater Shale Member - Greenish-gray to olive-green glauconitic shale, siltstone, and minor sandstone. Laminated to thin-bedded. Fine- to very fine-grained; calcareous. Contains the fossil belemnite <i>Pachyteuthis</i> sp. Thickness 40-50 ft (12.2-15.2 m) | Jp | LAK Member - Reddish-brown to brownish-orange, massive to poorly bedded siltstone and fine-grained sandstone. Thickness approximately 50-80 ft (15.2-24.4 m) | Jh | Hulet Sandstone Member - Tan to yellowish-orange, fine-grained, thin-bedded quartz arenite having thin shaly interbeds. Contains abundant ripple marks and trace fossils. Thickness approximately 40-50 ft (12.2-15.2 m) | Jb | Stockade Beaver Shale Member - Greenish-gray to olive green glauconitic shale, siltstone, and minor sandstone. Laminated to thin-bedded. Fine- to very fine-grained; calcareous. Contains the fossil belemnite <i>Pachyteuthis</i> sp. Thickness approximately 30-40 ft (9.1-12.2 m) | Jgs | Gypsum Spring Formation - Massive white to light-gray gypsum with thin interbedded reddish siltstone and shale. Thickness 35-40 ft (10.7-12.2 m) |
| Triassic | Tp | Feldspar porphyry - Shows only in cross section | Tu | Tertiary igneous rocks (undifferentiated) - Leucocratic to mesocratic, aphanitic to porphyritic, hypabyssal intrusive rocks. Includes phonolitic, rhyolitic, trachytic, and latitic rocks | Ks | Skull Creek Shale - Dark-gray to black fissile shale. Contains sparse ferruginous concretions. Minor fine-grained sandstone and bentonite at the base. Weathers easily to form a grass-covered slope. Exposed thickness approximately 9-120 ft (0.3-36.6 m) | Kf | Fall River Formation - Variegated yellowish-orange, reddish-brown, tan to white, fine-grained quartz arenite and brown to light-gray mudstone, siltstone, and carbonaceous beds. Thin- to medium-bedded. Thickness approximately 100-150 ft (30.5-45.7 m) | Kl | Lakota Formation - Yellowish-orange, tan to white, fine-grained quartz arenite and brown to light-gray mudstone and siltstone. Thin- to medium-bedded, locally with abundant cross bedding. Formation is poorly exposed. Thickness approximately 250 ft (76.2 m) | Mp | Morrison Formation - Variegated gray, green, to maroon bentonitic claystone, siltstone, and sandstone with minor limestone. Weathers with a popcorn-like appearance. Typically forms a grass-covered slope. Thickness approximately 40-140 ft (12.2-42.7 m) | Jb | Sundance Formation - Includes the following members which were observed in the field but not differentiated on the map or cross section. Formation is poorly exposed. Thickness approximately 250-285 ft (76.2-86.9 m) | Jm | Redwater Shale Member - Greenish-gray to olive-green glauconitic shale, siltstone, and minor sandstone. Laminated to thin-bedded. Fine- to very fine-grained; calcareous. Contains the fossil belemnite <i>Pachyteuthis</i> sp. Thickness 40-50 ft (12.2-15.2 m) | Jp | LAK Member - Reddish-brown to brownish-orange, massive to poorly bedded siltstone and fine-grained sandstone. Thickness approximately 50-80 ft (15.2-24.4 m) | Jh | Hulet Sandstone Member - Tan to yellowish-orange, fine-grained, thin-bedded quartz arenite having thin shaly interbeds. Contains abundant ripple marks and trace fossils. Thickness approximately 40-50 ft (12.2-15.2 m) | Jb | Stockade Beaver Shale Member - Greenish-gray to olive green glauconitic shale, siltstone, and minor sandstone. Laminated to thin-bedded. Fine- to very fine-grained; calcareous. Contains the fossil belemnite <i>Pachyteuthis</i> sp. Thickness approximately 30-40 ft (9.1-12.2 m) | Jgs | Gypsum Spring Formation - Massive white to light-gray gypsum with thin interbedded reddish siltstone and shale. Thickness 35-40 ft (10.7-12.2 m) |
| Permian | Pm | Minnekahta Limestone - Pink, purple, to beige limestone. Laminated to thin-bedded. Middle and basal beds shaly. Contains abundant stylolites, small fossils, and is locally karstic. Has a petrifolios odor when broken. Thickness 40-50 ft (12.2-15.2 m) | Pp | Opeche Shale - Red to maroon shale and siltstone. Purplish coloring due to groundwater alteration occurs in the upper few feet. Fine-grained, poorly consolidated. Poorly exposed, typically forming a grass-covered slope. Thickness of 90-150 ft (27.4-45.7 m) reported from well completion reports | PPh | Minnelusa Formation - Red, brown, yellow to beige sandstone, shale, limestone, and dolomite. Red shale and siltstone occur along the basal lower contact with the Pahasapa Limestone. Thickness of 500-600 ft (152.4-182.9 m) reported from well completion reports | Pp | Opeche Shale - Red to maroon shale and siltstone. Purplish coloring due to groundwater alteration occurs in the upper few feet. Fine-grained, poorly consolidated. Poorly exposed, typically forming a grass-covered slope. Thickness of 90-150 ft (27.4-45.7 m) reported from well completion reports | PPh | Minnelusa Formation - Red, brown, yellow to beige sandstone, shale, limestone, and dolomite. Red shale and siltstone occur along the basal lower contact with the Pahasapa Limestone. Thickness of 500-600 ft (152.4-182.9 m) reported from well completion reports | Pp | Opeche Shale - Red to maroon shale and siltstone. Purplish coloring due to groundwater alteration occurs in the upper few feet. Fine-grained, poorly consolidated. Poorly exposed, typically forming a grass-covered slope. Thickness of 90-150 ft (27.4-45.7 m) reported from well completion reports | PPh | Minnelusa Formation - Red, brown, yellow to beige sandstone, shale, limestone, and dolomite. Red shale and siltstone occur along the basal lower contact with the Pahasapa Limestone. Thickness of 500-600 ft (152.4-182.9 m) reported from well completion reports | | | | | | | | | | |
| Pennsylvanian | Pp | Opeche Shale - Red to maroon shale and siltstone. Purplish coloring due to groundwater alteration occurs in the upper few feet. Fine-grained, poorly consolidated. Poorly exposed, typically forming a grass-covered slope. Thickness of 90-150 ft (27.4-45.7 m) reported from well completion reports | PPh | Minnelusa Formation - Red, brown, yellow to beige sandstone, shale, limestone, and dolomite. Red shale and siltstone occur along the basal lower contact with the Pahasapa Limestone. Thickness of 500-600 ft (152.4-182.9 m) reported from well completion reports | Pp | Opeche Shale - Red to maroon shale and siltstone. Purplish coloring due to groundwater alteration occurs in the upper few feet. Fine-grained, poorly consolidated. Poorly exposed, typically forming a grass-covered slope. Thickness of 90-150 ft (27.4-45.7 m) reported from well completion reports | PPh | Minnelusa Formation - Red, brown, yellow to beige sandstone, shale, limestone, and dolomite. Red shale and siltstone occur along the basal lower contact with the Pahasapa Limestone. Thickness of 500-600 ft (152.4-182.9 m) reported from well completion reports | Pp | Opeche Shale - Red to maroon shale and siltstone. Purplish coloring due to groundwater alteration occurs in the upper few feet. Fine-grained, poorly consolidated. Poorly exposed, typically forming a grass-covered slope. Thickness of 90-150 ft (27.4-45.7 m) reported from well completion reports | PPh | Minnelusa Formation - Red, brown, yellow to beige sandstone, shale, limestone, and dolomite. Red shale and siltstone occur along the basal lower contact with the Pahasapa Limestone. Thickness of 500-600 ft (152.4-182.9 m) reported from well completion reports | | | | | | | | | | | | |
| Mississippian | Mp | Pahasapa Limestone - White, beige to brown chert, and local siltstone. Contains thin lenses and beds of gray to brown chert, and local siltstone breccia. Vuggy, with caves occurring mainly in the upper third of the formation. Forms prominent cliffs. Thickness of 400-500 ft (121.9-152.4 m) reported from well completion reports | Md | Englewood Limestone - Pink, gray to purple-gray argillaceous limestone, limestone, and dolomite. Laminated to medium-bedded. Only to medium crystalline; biturbidated. Thickness of 30-65 ft (9.1-19.8 m) reported from well completion reports | Mw | Whitewood Limestone - Variegated yellowish-brown, brownish-orange to gray dolomitic limestone and dolomite. Thin-bedded to massive, with thin shale partings. Thickness of 60-80 ft (18.3-24.4 m) reported from well completion reports | Mv | Winnipeg Formation - Includes the Icebox Shale Member of greenish-gray, fissile shale and the Roughlock Siltstone Member of tan to yellowish-gray, calcareous siltstone. Combined thickness of 70-75 ft (21.3-22.9 m) reported from well completion reports | Md | Englewood Limestone - Pink, gray to purple-gray argillaceous limestone, limestone, and dolomite. Laminated to medium-bedded. Only to medium crystalline; biturbidated. Thickness of 30-65 ft (9.1-19.8 m) reported from well completion reports | Mw | Whitewood Limestone - Variegated yellowish-brown, brownish-orange to gray dolomitic limestone and dolomite. Thin-bedded to massive, with thin shale partings. Thickness of 60-80 ft (18.3-24.4 m) reported from well completion reports | Mv | Winnipeg Formation - Includes the Icebox Shale Member of greenish-gray, fissile shale and the Roughlock Siltstone Member of tan to yellowish-gray, calcareous siltstone. Combined thickness of 70-75 ft (21.3-22.9 m) reported from well completion reports | | | | | | | | | | |
| Devonian | Md | Englewood Limestone - Pink, gray to purple-gray argillaceous limestone, limestone, and dolomite. Laminated to medium-bedded. Only to medium crystalline; biturbidated. Thickness of 30-65 ft (9.1-19.8 m) reported from well completion reports | Mw | Whitewood Limestone - Variegated yellowish-brown, brownish-orange to gray dolomitic limestone and dolomite. Thin-bedded to massive, with thin shale partings. Thickness of 60-80 ft (18.3-24.4 m) reported from well completion reports | Mv | Winnipeg Formation - Includes the Icebox Shale Member of greenish-gray, fissile shale and the Roughlock Siltstone Member of tan to yellowish-gray, calcareous siltstone. Combined thickness of 70-75 ft (21.3-22.9 m) reported from well completion reports | Md | Englewood Limestone - Pink, gray to purple-gray argillaceous limestone, limestone, and dolomite. Laminated to medium-bedded. Only to medium crystalline; biturbidated. Thickness of 30-65 ft (9.1-19.8 m) reported from well completion reports | Mw | Whitewood Limestone - Variegated yellowish-brown, brownish-orange to gray dolomitic limestone and dolomite. Thin-bedded to massive, with thin shale partings. Thickness of 60-80 ft (18.3-24.4 m) reported from well completion reports | Mv | Winnipeg Formation - Includes the Icebox Shale Member of greenish-gray, fissile shale and the Roughlock Siltstone Member of tan to yellowish-gray, calcareous siltstone. Combined thickness of 70-75 ft (21.3-22.9 m) reported from well completion reports | | | | | | | | | | | | |
| Ordovician | Ocd | Deadwood Formation - Greenish- to reddish-brown glauconitic sandstone, shale, limestone, intraformational conglomerate, and local basal conglomerate. Laminated to thick-bedded. Thickness 240-423 ft (73.2-128.9 m) | Oxg | Grizzly Formation - Gray, bluish-gray to dark-gray phyllite, slate, platy mica schist, and minor metagraywacke. Some beds are carbonaceous. Protolith is dominantly shale and siltstone | Ox | Flag Rock Formation - Light-gray to greenish-gray mica schist and laminated pyritic and carbonaceous phyllite. Contains pillowed metabasalt, streaked graphitic quartzite, metachert, and metamorphosed carbonate-facies iron formation with cummingtonite, biotite, and chlorite similar in appearance to the Homestake Formation. Thickness up to 5250 ft (1600.2 m) in the area of the Homestake Mine (Slaughter, 1968; Caddey et al., 1991) on the Lead quadrangle. Protolith of formation is pillow basalt with interflow deposits of siltstone, carbonaceous shale, chert, and iron carbonate | Ox | Flag Rock Formation - Light-gray to greenish-gray mica schist and laminated pyritic and carbonaceous phyllite. Contains pillowed metabasalt, streaked graphitic quartzite, metachert, and metamorphosed carbonate-facies iron formation with cummingtonite, biotite, and chlorite similar in appearance to the Homestake Formation. Thickness up to 5250 ft (1600.2 m) in the area of the Homestake Mine (Slaughter, 1968; Caddey et al., 1991) on the Lead quadrangle. Protolith of formation is pillow basalt with interflow deposits of siltstone, carbonaceous shale, chert, and iron carbonate | Ox | Flag Rock Formation - Light-gray to greenish-gray mica schist and laminated pyritic and carbonaceous phyllite. Contains pillowed metabasalt, streaked graphitic quartzite, metachert, and metamorphosed carbonate-facies iron formation with cummingtonite, biotite, and chlorite similar in appearance to the Homestake Formation. Thickness up to 5250 ft (1600.2 m) in the area of the Homestake Mine (Slaughter, 1968; Caddey et al., 1991) on the Lead quadrangle. Protolith of formation is pillow basalt with interflow deposits of siltstone, carbonaceous shale, chert, and iron carbonate | Ox | Flag Rock Formation - Light-gray to greenish-gray mica schist and laminated pyritic and carbonaceous phyllite. Contains pillowed metabasalt, streaked graphitic quartzite, metachert, and metamorphosed carbonate-facies iron formation with cummingtonite, biotite, and chlorite similar in appearance to the Homestake Formation. Thickness up to 5250 ft (1600.2 m) in the area of the Homestake Mine (Slaughter, 1968; Caddey et al., 1991) on the Lead quadrangle. Protolith of formation is pillow basalt with interflow deposits of siltstone, carbonaceous shale, chert, and iron carbonate | Ox | Flag Rock Formation - Light-gray to greenish-gray mica schist and laminated pyritic and carbonaceous phyllite. Contains pillowed metabasalt, streaked graphitic quartzite, metachert, and metamorphosed carbonate-facies iron formation with cummingtonite, biotite, and chlorite similar in appearance to the Homestake Formation. Thickness up to 5250 ft (1600.2 m) in the area of the Homestake Mine (Slaughter, 1968; Caddey et al., 1991) on the Lead quadrangle. Protolith of formation is pillow basalt with interflow deposits of siltstone, carbonaceous shale, chert, and iron carbonate | | | | | | | | | | |
| Cambrian | Ocd | Deadwood Formation - Greenish- to reddish-brown glauconitic sandstone, shale, limestone, intraformational conglomerate, and local basal conglomerate. Laminated to thick-bedded. Thickness 240-423 ft (73.2-128.9 m) | Oxg | Grizzly Formation - Gray, bluish-gray to dark-gray phyllite, slate, platy mica schist, and minor metagraywacke. Some beds are carbonaceous. Protolith is dominantly shale and siltstone | Ox | Flag Rock Formation - Light-gray to greenish-gray mica schist and laminated pyritic and carbonaceous phyllite. Contains pillowed metabasalt, streaked graphitic quartzite, metachert, and metamorphosed carbonate-facies iron formation with cummingtonite, biotite, and chlorite similar in appearance to the Homestake Formation. Thickness up to 5250 ft (1600.2 m) in the area of the Homestake Mine (Slaughter, 1968; Caddey et al., 1991) on the Lead quadrangle. Protolith of formation is pillow basalt with interflow deposits of siltstone, carbonaceous shale, chert, and iron carbonate | Ox | Flag Rock Formation - Light-gray to greenish-gray mica schist and laminated pyritic and carbonaceous phyllite. Contains pillowed metabasalt, streaked graphitic quartzite, metachert, and metamorphosed carbonate-facies iron formation with cummingtonite, biotite, and chlorite similar in appearance to the Homestake Formation. Thickness up to 5250 ft (1600.2 m) in the area of the Homestake Mine (Slaughter, 1968; Caddey et al., 1991) on the Lead quadrangle. Protolith of formation is pillow basalt with interflow deposits of siltstone, carbonaceous shale, chert, and iron carbonate | Ox | Flag Rock Formation - Light-gray to greenish-gray mica schist and laminated pyritic and carbonaceous phyllite. Contains pillowed metabasalt, streaked graphitic quartzite, metachert, and metamorphosed carbonate-facies iron formation with cummingtonite, biotite, and chlorite similar in appearance to the Homestake Formation. Thickness up to 5250 ft (1600.2 m) in the area of the Homestake Mine (Slaughter, 1968; Caddey et al., 1991) on the Lead quadrangle. Protolith of formation is pillow basalt with interflow deposits of siltstone, carbonaceous shale, chert, and iron carbonate | Ox | Flag Rock Formation - Light-gray to greenish-gray mica schist and laminated pyritic and carbonaceous phyllite. Contains pillowed metabasalt, streaked graphitic quartzite, metachert, and metamorphosed carbonate-facies iron formation with cummingtonite, biotite, and chlorite similar in appearance to the Homestake Formation. Thickness up to 5250 ft (1600.2 m) in the area of the Homestake Mine (Slaughter, 1968; Caddey et al., 1991) on the Lead quadrangle. Protolith of formation is pillow basalt with interflow deposits of siltstone, carbonaceous shale, chert, and iron carbonate | | | | | | | | | | | | |
| Precambrian | Ocd | Deadwood Formation - Greenish- to reddish-brown glauconitic sandstone, shale, limestone, intraformational conglomerate, and local basal conglomerate. Laminated to thick-bedded. Thickness 240-423 ft (73.2-128.9 m) | Oxg | Grizzly Formation - Gray, bluish-gray to dark-gray phyllite, slate, platy mica schist, and minor metagraywacke. Some beds are carbonaceous. Protolith is dominantly shale and siltstone | Ox | Flag Rock Formation - Light-gray to greenish-gray mica schist and laminated pyritic and carbonaceous phyllite. Contains pillowed metabasalt, streaked graphitic quartzite, metachert, and metamorphosed carbonate-facies iron formation with cummingtonite, biotite, and chlorite similar in appearance to the Homestake Formation. Thickness up to 5250 ft (1600.2 m) in the area of the Homestake Mine (Slaughter, 1968; Caddey et al., 1991) on the Lead quadrangle. Protolith of formation is pillow basalt with interflow deposits of siltstone, carbonaceous shale, chert, and iron carbonate | Ox | Flag Rock Formation - Light-gray to greenish-gray mica schist and laminated pyritic and carbonaceous phyllite. Contains pillowed metabasalt, streaked graphitic quartzite, metachert, and metamorphosed carbonate-facies iron formation with cummingtonite, biotite, and chlorite similar in appearance to the Homestake Formation. Thickness up to 5250 ft (1600.2 m) in the area of the Homestake Mine (Slaughter, 1968; Caddey et al., 1991) on the Lead quadrangle. Protolith of formation is pillow basalt with interflow deposits of siltstone, carbonaceous shale, chert, and iron carbonate | Ox | Flag Rock Formation - Light-gray to greenish-gray mica schist and laminated pyritic and carbonaceous phyllite. Contains pillowed metabasalt, streaked graphitic quartzite, metachert, and metamorphosed carbonate-facies iron formation with cummingtonite, biotite, and chlorite similar in appearance to the Homestake Formation. Thickness up to 5250 ft (1600.2 m) in the area of the Homestake Mine (Slaughter, 1968; Caddey et al., 1991) on the Lead quadrangle. Protolith of formation is pillow basalt with interflow deposits of siltstone, carbonaceous shale, chert, and iron carbonate | Ox | Flag Rock Formation - Light-gray to greenish-gray mica schist and laminated pyritic and carbonaceous phyllite. Contains pillowed metabasalt, streaked graphitic quartzite, metachert, and metamorphosed carbonate-facies iron formation with cummingtonite, biotite, and chlorite similar in appearance to the Homestake Formation. Thickness up to 5250 ft (1600.2 m) in the area of the Homestake Mine (Slaughter, 1968; Caddey et | | | | | | | | | | | | |