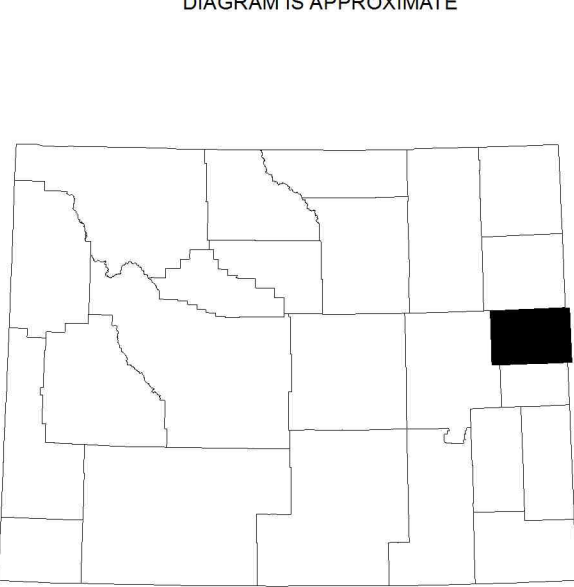


Base map from U.S. Geological Survey 1:100,000 - scale
map; topographic map of the Lance Creek, Wyoming
30' x 60' Quadrangle, 1981
Projection: Universal Transverse Mercator (UTM), zone 13
North American Datum of 1983 (NAD 83)
10,000-meter grid ticks UTM, zone 13
25,000-foot grid ticks Wyoming State Plane Coordinate
System, east zone

UTM GRID CONVERGENCE (GN)
1981 MAGNETIC DECLINATION (MN) AT CENTER OF SHEET
DIAGRAM IS APPROXIMATE



WYOMING QUADRANGLE LOCATION

REFERENCES CITED AND SOURCES OF GEOLOGIC DATA
(Numbers are those on INDEX TO GEOLOGIC MAPPING)

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Compiled and mapped by
Joseph F. Johnson and David C. Micalo
2008

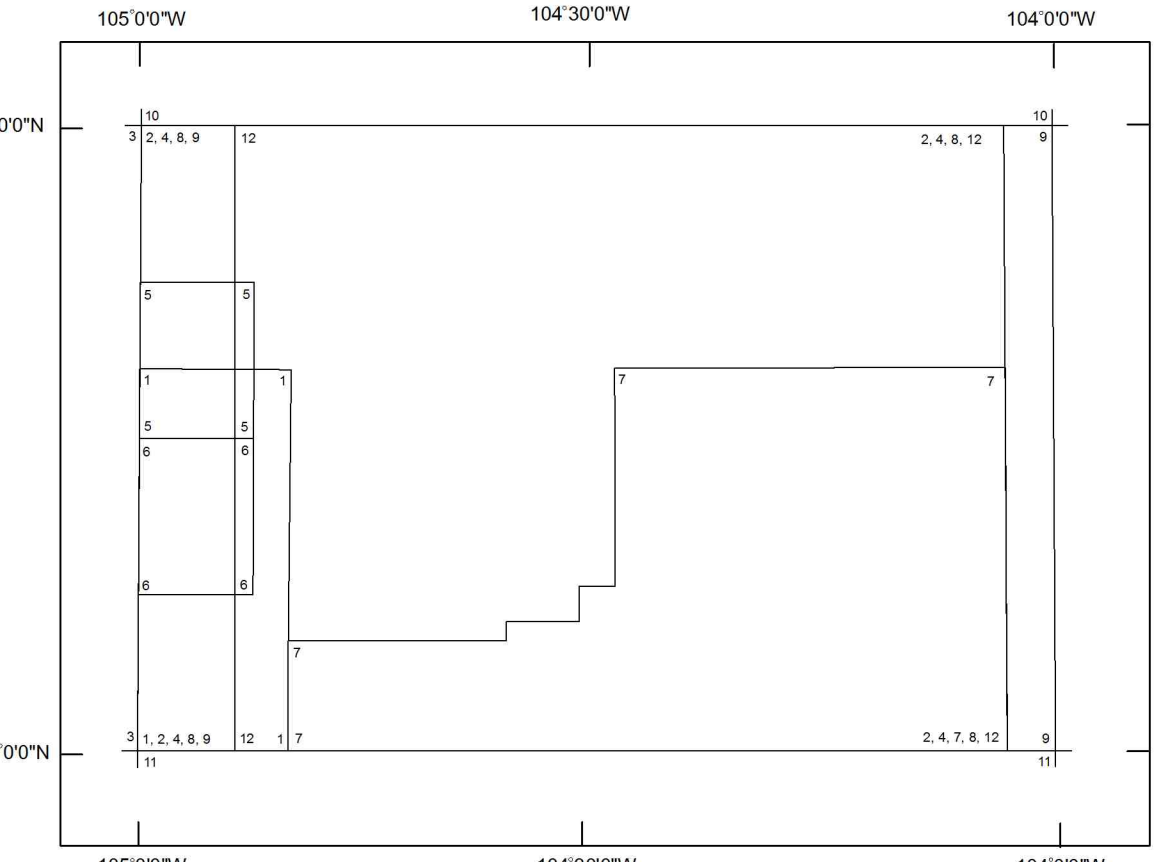
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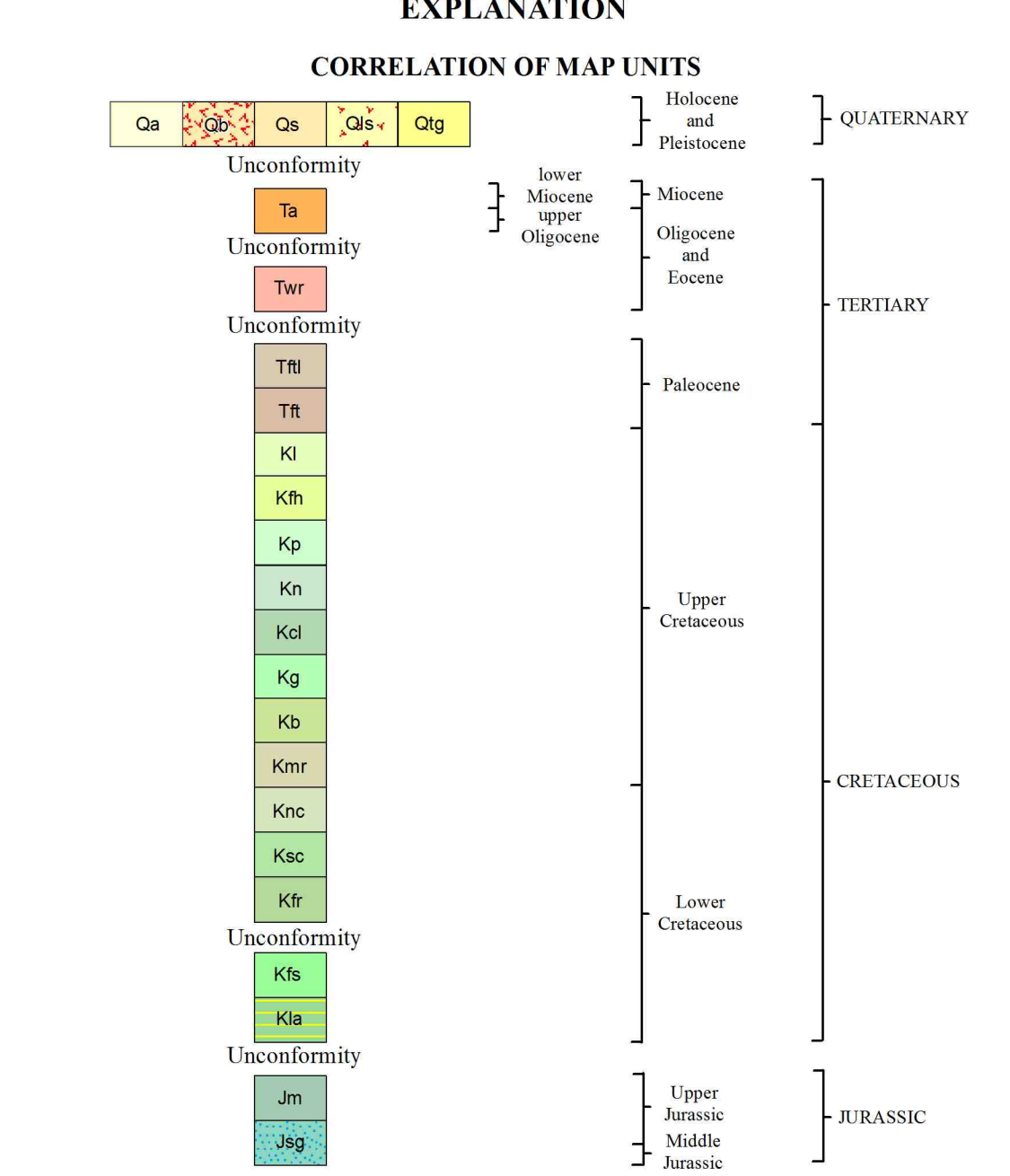
Digital cartography by Joseph F. Johnson, David C. Micalo,
and Thomas E. Ver Ploeg

Map design and editing by Richard W. Jones

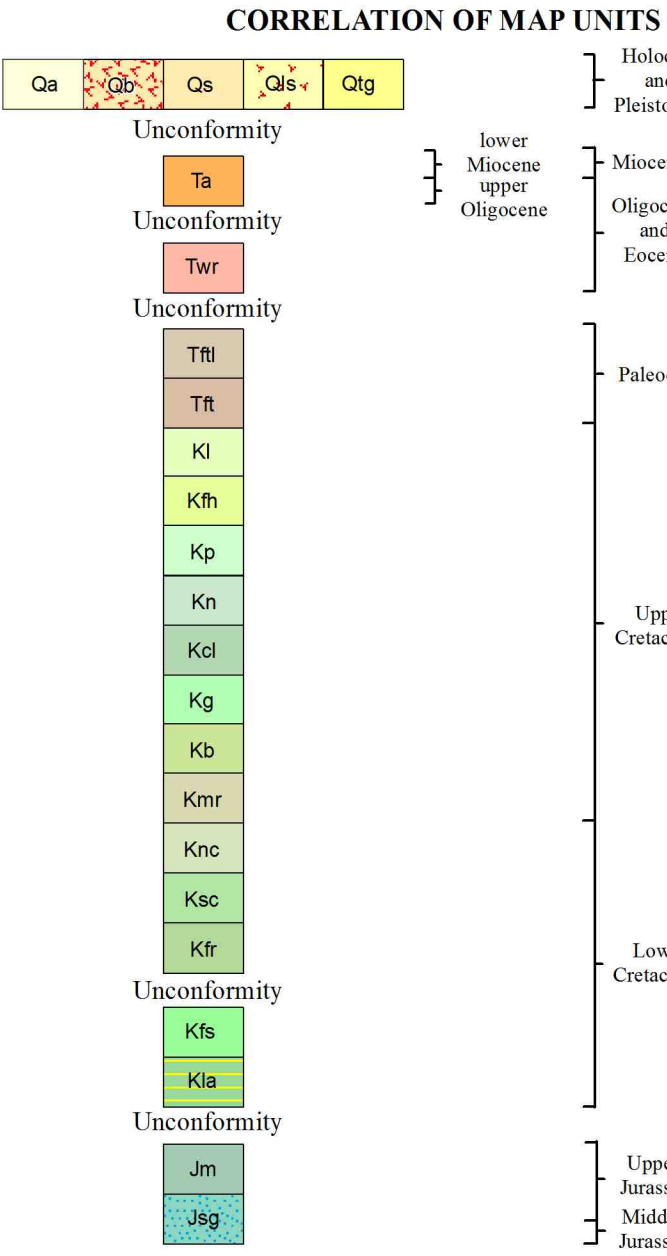
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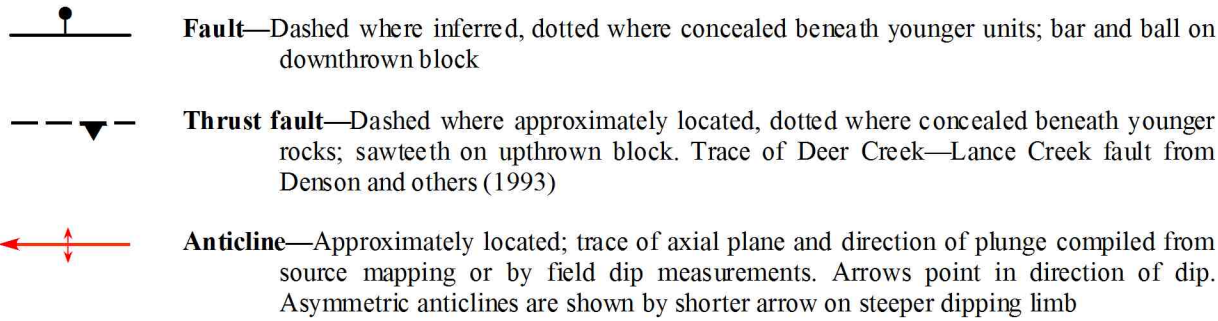
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(Numbers are those listed in the REFERENCES CITED
AND SOURCES OF GEOLOGIC DATA)



EXPLANATION



MAP SYMBOLS



DESCRIPTION OF MAP UNITS

Quaternary surficial deposits

- Qa** Alluvium (Holocene/Pleistocene)—Unconsolidated and poorly consolidated clay, silt, sand, and gravel; includes deposits underlying current floodplains and bordering terraces (modified from Love and others, 1987)
- Qal** Baked and fused rock (clinker) (Holocene/Pleistocene)—Hard, dense, red to orange baked shale and siltstone, and some bubbly, glassy rock caused by thermal alteration of overlying strata from burning coal beds in Fort Union Formation. Forms scarp or mesa with local talus slopes at base where blocks and debris have detached and moved down slope
- Qs** Windblown sand (Holocene/Pleistocene)—Chiefly quartz sand; includes active and dormant sand dunes (Love and others, 1987)
- Qls** Landslide deposits (Holocene/Pleistocene)—Chaotically mixed boulders and fine-grained rock debris (Love and others, 1987); may include slope wash (Hallberg and Case, 1999)
- Qlg** Terrace gravel (Holocene/Pleistocene)—Older terrace deposits above younger terraces along present stream levels; may include some high-level deposits of Tertiary age (modified from Love and others, 1987)

Tertiary sedimentary rocks

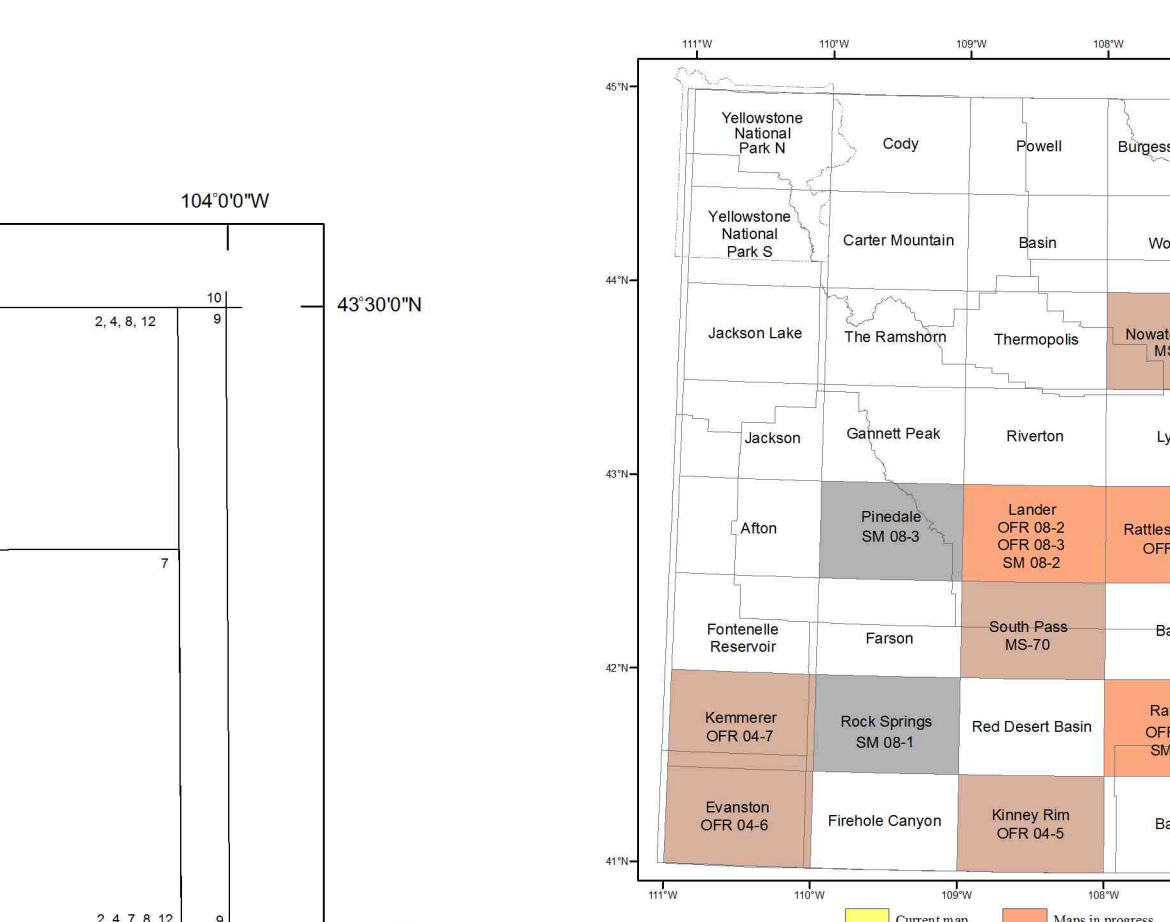
- Ta** Aricaire Formation (lower Miocene and upper Oligocene)—Light-gray to brownish-gray sandstone, very fine- to fine-grained, poorly bedded, contains some siltstone, limestone, and tuff; lenticular conglomerate near base; thickness from 0 to 600 feet (0 to 180 m) (modified from Whitcomb and Cummings, 1965; Love and others, 1987)
- Tw** White River Group (Oligocene, and Eocene)—White, pink, green, and brown tuffaceous claystone and siltstone; contains thin beds of ash and limestone; locally contains channel deposits of fine to coarse, loosely cemented sandstone and conglomerate; thickness from 0 to 500 feet (Love and others, 1987; Whitcomb and Cummings, 1965). Individual formations that compose the group (the Chadron and Brule formations) were not distinguished
- Fu** Fort Union Formation (Paleocene)—Composed of three members; the upper two members are mapped together because of similarities in lithology and the difficulty in mapping the contact between them
- Tu** Tongue River and Lobo members undivided—Upper part (Tongue River) is drab to gray fine-grained sandstone, finely conglomeratic in places; interbedded with drab siltstone, claystone, and shale; thick coal beds near top. Lower part (Lobo) is gray shale and claystone. Total thickness from 0 to 2,500 feet (0 to 760 m) (Love and others, 1987)
- Tt** Tubbek Formation—Drab gray shale and siltstone; contains massive sandstone, in contrast to the Lobo which is lighter in color and contains more shale and claystone; thickness from 0 to 1,300 feet (0 to 400 m) (modified from Love and others, 1987)

- Uc** Upper Cretaceous sedimentary rocks
- Kl** Lance Formation—White to yellowish-gray and brown, fine- to medium-grained sandstone interbedded with gray and black claystone containing thin beds of carbonaceous shale and coal; somber-colored shale and drab, massive, lenticular, concretionary sandstones; many thin coal beds in the lower half; thickness from 1,500 to 2,500 feet (460 to 760 m) (Whitcomb and Cummings, 1965; Love and others, 1987)
- Kf** Fox Hills Sandstone—Light-gray, yellow and brown sandstone, fine- to medium-grained, poorly cemented, ridge forming; contains thin beds of dark sandy shale; thickness from 350 to 550 feet (110 to 170 m) (modified from Whitcomb and Cummings, 1965); contains marine fossils (Love and others, 1987)
- Kp** Pierre Shale—Predominantly dark-colored shale and siltstone; contains five members but mapped as one unit; total thickness of all members is from 2,500 to 3,100 feet (760 to 910 m) (Whitcomb and Cummings, 1965; Love and others, 1987). Type locality is located in the vicinity of Red Bird, Niobrara County, Wyoming; descriptions of the members from Gill and Cobban (1966)

- Kb** Karoo Member—Light olive-gray weathering, silty bentonitic shale; bentonite beds are common and can reach 6 feet (1.8 m) in thickness at base of member; fossiliferous gray- and brown-weathering limestone concretions are present
- Kc** Red Bird Shale Member—Soft silty shale; weathers to light gray; yellow-, orange-, and unweathering, fossiliferous limestone concretions are common
- Kd** Mitten Black Shale Member—Gray to black fissile shales containing numerous rusty weathering limestone and ironstone concretions; locally, a basal unit composed of polished black phosphatic pebbles and rounded bone fragments, rests unconformably on the Gammon Ferruginous Member (where the Sharon Springs Member is absent)
- Sh** Sharon Springs Member—Dark-gray fissile shale, harder than continuous units; lower part is rich in organic material and contains several bentonitic beds, the largest of which is the Ardmore Bentonite at the base; typically supports life vegetation
- Gf** Gammon Ferruginous Member—Dark-gray, noncalcareous shale, hard, platy weathering; contains several thin beds of yellowish bentonite and some widely separated layers of red-weathering siltstone concretions; similar in appearance and conformable with the lower part of the Sharon Springs Member

- Km** Karoo Member—Light olive-gray weathering, silty bentonitic shale; bentonite beds are common and can reach 6 feet (1.8 m) in thickness at base of member; fossiliferous gray- and brown-weathering limestone concretions are present
- Kc** Red Bird Shale Member—Soft silty shale; weathers to light gray; yellow-, orange-, and unweathering, fossiliferous limestone concretions are common
- Kd** Mitten Black Shale Member—Gray to black fissile shales containing numerous rusty weathering limestone and ironstone concretions; locally, a basal unit composed of polished black phosphatic pebbles and rounded bone fragments, rests unconformably on the Gammon Ferruginous Member (where the Sharon Springs Member is absent)
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KEY TO ABBREVIATIONS
U.S. Geological Survey maps: Miscellaneous Investigations Series (I), Wyoming State Geological Survey maps: Map Series (M), Open File Report (OFR), Preliminary Geologic Map (PGM), Hazards Section Digital Map (HSDM), and unpublished STATEMAP project (SMP).

Upper Cretaceous sedimentary rocks (continued)

- Kn** Niobrara Formation—Liney, gray to black shale, chalky marl, limestone, and shaly limestone; thickness from 100 to 250 feet (30 to 76 m) (modified from Johnson, 1962; Whitcomb and Cummings, 1965)
- Kcl** Carlile Shale—Dark-gray to black, soft, sandy shale (Love and others, 1987); contains three members but mapped as one unit; total thickness of all members ranges from 450 to 550 feet (140 to 170 m) (modified from Whitcomb and Cummings, 1965)
- Sm** Sage Breaks Member—Soft, grayish-black calcareous shale with gray-weathering limestone concretions; thickness ~260 feet (79 m)
- Tsm** Turner Sandy Member—Gray, ridge-forming, sandy shale and rusty sandstone; contains tan-weathering silty concretions; thickness ~150 feet (46 m)
- Uc** Unnamed lower member—Dark-gray shale containing fossiliferous concretions and numerous siltstone beds near top of unit; thickness from 90 to 110 feet (27 to 34 m)

- Uc** Unnamed lower member—Dark-gray shale containing fossiliferous concretions and numerous siltstone beds near top of unit; thickness from 90 to 110 feet (27 to 34 m)
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- Uc** Unnamed lower member—Dark-gray shale containing fossiliferous concretions and numerous siltstone beds near top of unit; thickness from 90 to 110 feet (27 to 34 m)

Lower Cretaceous sedimentary rocks

- Knc** Newcastle Sandstone—Light-gray sandstone, fine- to medium-grained; contains beds of dark-gray siltstone and claystone; in places conglomeratic; thin-bedded to massive and lenticular; thickness 0 to 100 feet (0 to 30 m) (Whitcomb and Cummings, 1965)
- Ksc** Skull Creek Shale—Black, soft, fissile shale; contains some ferruginous sandstone and iron concretions; thickness 160 to 200 feet (49 to 61 m) (Whitcomb and Cummings, 1965; Love and others, 1987)
- Ik** Iyau Kara Group—Includes Fall River Formation, Fuson Shale, and the Lakota Formation; total thickness 150 to 300 feet (46 to 91 m) (Whitcomb and Cummings, 1965)
- Kf** Fall River Formation—Mostly brown, fine-grained sandstone with some associated siltstones and shales; thickness 35 to 75 feet (11 to 23 m) (Johnson, 1962; Love and others, 1987)
- Ks** Fuson Shale—Massive claystone and shale beds that weather to a light color; thickness 25 to 50 feet (7.6 to 15 m); type locality is located in sec. 8, T. 36 N., R. 62 W. (Johnson, 1962)
- Kl** Lakota Formation—Resistant sandstone, coarse-grained, cross-bedded and chert pebble conglomerate; thickness ~100 feet (30 m) (Johnson, 1962)

Jurassic sedimentary rocks

- Jm** Morrison Formation (Upper Jurassic)—Dolily variegated siliceous claystone containing nodular limestone and gray, silty sandstone lenses; thickness 50 to 100 feet (15 to 30 m) (Love and others, 1987)
- Jsg** Sundance and Gypsum Spring Formations undivided
- Sd** Sundance Formation (Upper and Middle Jurassic)—Greenish-gray glauconitic sandstone and shale underlain by red and gray non-glauconitic sandstone and shale; thickness 350 to 400 feet (110 to 120 m) (Love and others, 1987)
- Gs** Gypsum Spring Formation (Middle Jurassic)—Massive white gypsum and red shale; thickness 0 to 20 feet (0 to 6 m) (Love and others, 1987)

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