WYOMING STATE GEOLOGICAL SURVEY
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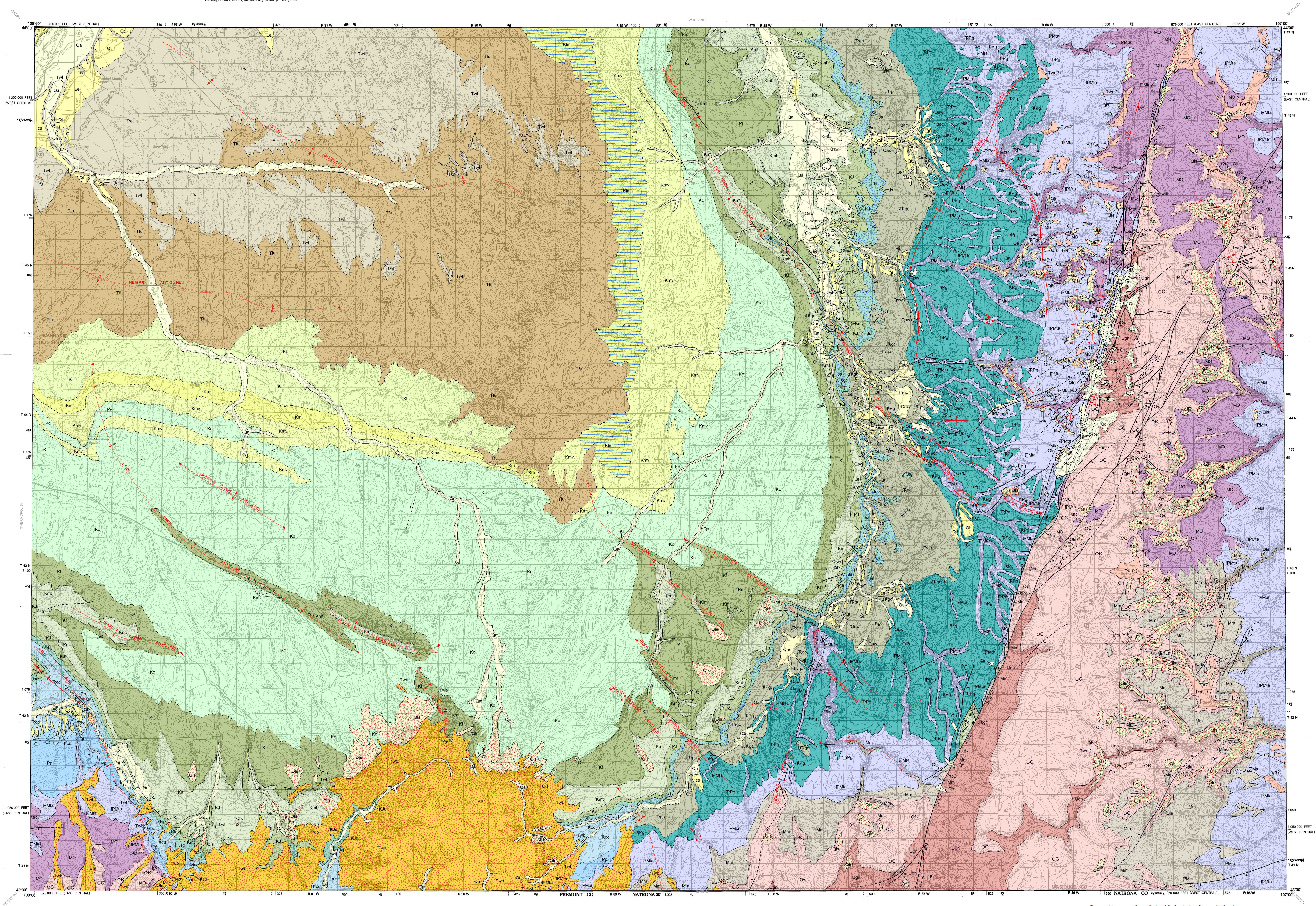
Geology - Interpreting the past to provide for the future

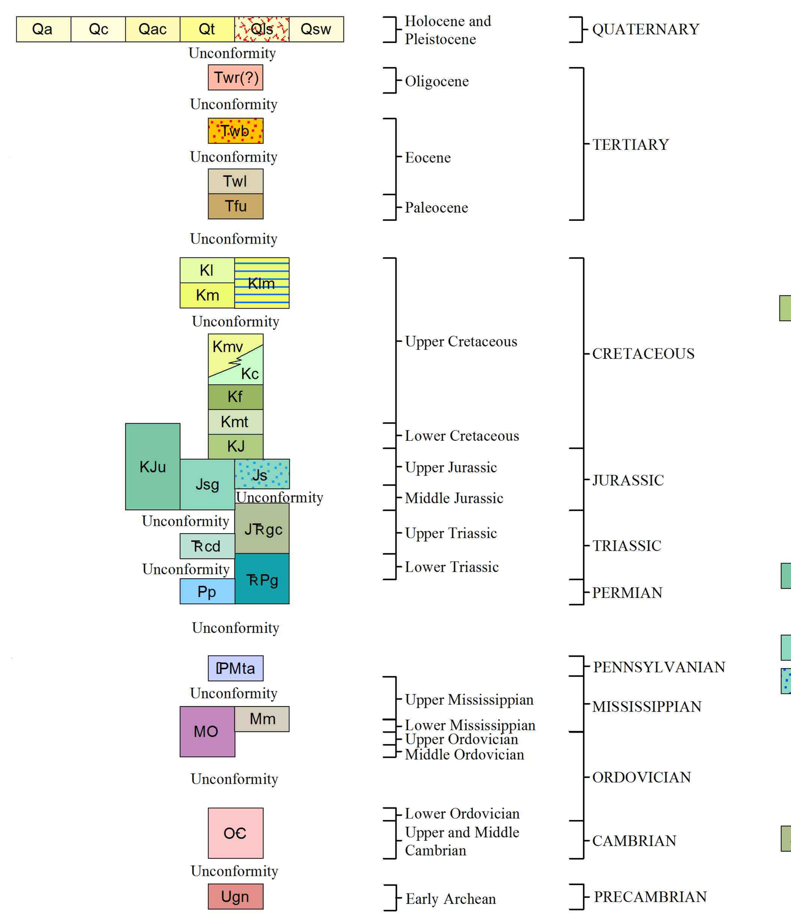
Prepared in cooperation with the
U.S. GEOLOGICAL SURVEY

MAP SERIES 39
Nowater Creek 1:100,000 - scale Geologic Map



EXPLANATION

CORRELATION OF MAP UNITS



MAP SYMBOLS

Contact—Dashed where approximately located

Fault—Dashed where approximately located; dotted where concealed. Bar and ball on downthrown side

Anticline—Trace of axis and direction of plunge. Shorter arrow indicates limb of fold with steeper dip. Dashed where approximately located

Monocline—Trace located on anticlinal hinge of fold. Shorter arrow indicates steeper limb of fold. Dashed where approximately located

DESCRIPTION OF MAP UNITS

Holocene and Pleistocene surficial deposits

Qa — **Alluvial deposits**—Unconsolidated and poorly consolidated clay, silt, sand, and gravel, mainly in floodplains and lowest stream terraces

Qc — **Colluvium**—Unconsolidated masses of rock fragments and soil material on relatively steep slopes with thickest accumulations at the bases of slopes. Most conspicuous and common constituents are cobbles, boulders, and large slabs of Flathead Sandstone mixed with some Precambrian rocks. Located adjacent to and covering portions of the Big Trails fault system in the eastern part of the map

Qac — **Mixed alluvium and colluvium**—Unconsolidated tributary stream alluvium and colluvium

Qt — **Terrace deposits**—Silt, sand, and gravel in higher stream terraces; located primarily along the Bighorn and Nowood Rivers and their tributaries

Qls — **Landslide and talus deposits**—Well-defined slumped areas and debris flows ranging from large blocks of bedrock, to boulder size, to clay size. Emplaced by mass movement

Qsw — **Slope-wash deposits**—Unconsolidated alluvial deposits sloping down and away from dipping bedrock on the western flanks of the Bighorn Mountains and merging with terrace deposits near Nowood River and its tributaries; in some cases may include terrace deposits

Tertiary sedimentary rocks

Twr(?) — **White River Formation(?) (Oligocene)**—White, gray, pink, and brown tuffaceous claystone interbedded with lenticular gravel or conglomerate beds. Deposited in pre-Oligocene(?) valleys cut into Paleozoic rocks in the Bighorn Mountains. Similar to rocks described by Hose (1955) as White River Formation in the Bighorn Mountains immediately northeast of this map. Thickness less than 100 feet (33 m)

Twb — **Wagon Bed Formation (Eocene)**—Green and gray tuffaceous claystone, sandstone, and conglomerate; locally contains oil shale. Thickness up to 1000 feet (333 m)

Twl — **Willwood Formation (Eocene)**—Red, purple, orange, and gray variegated mudstones interbedded with lenticular sandstones; vertebrate fossils common in bluish-gray mudstones. Thickness up to 500 feet (167 m)

Tfu — **Fort Union Formation (Paleocene)**—Upper part primarily olive-gray to drab yellow siltstone and mudstone; middle and lower parts contain abundant gray channel sandstones intertonguing with gray to black carbonaceous shale and thin coal beds. Zones of ferruginous concretions are common. Thickness up to 1500 feet (500 m), thinning to the south and east

Upper Cretaceous sedimentary rocks

Klm — **Lance and Meeteetse formations undivided**

Kl — **Lance Formation**—Mostly buff sandstone, with carbonaceous shale and gray to green shale. Sandstones contain oval calcareous concretions. Some thin coal beds. Massive, cliff-forming, white to yellow sandstone locally present at base. Thickness 700 to 1000 feet (233 to 333 m)

Km — **Meeteetse Formation**—Chalky white to gray, thin-bedded sandstones; yellow, green, and gray bentonitic claystone; white tuff; and thin coal beds. Thickness 410 to 650 feet (137 to 217 m)

Kmv — **Mesaverde Formation**—Gray to tan, massive to thin-bedded sandstone, gray sandy shale, carbonaceous shale, and coal beds. In western part of the map, upper and lower parts are separated by a tongue of Cody Shale. Thickness 550 to 1250 feet (183 to 417 m), thinning to the east.

Kc — **Cody Shale**—Dull gray shale containing calcareous concretions, interbedded with gray siltstones, thin, gray, fine-grained lenticular sandstones, and some thin bentonite beds. Intertongues with overlying Mesaverde Formation in western part of mapped area. Thickness 2600 to 3700 feet (867 to 1233 m)

Kf — **Frontier Formation**—Lenticular gray sandstones, some conglomeratic, interbedded with gray to black shale, thin bentonites, and tuffs. Sandstone has salt-and-pepper appearance. Contact with Cody Shale at top of highest persistent sandstone. Thickness 430 to 700 feet (143 to 233 m)

Kmt — **Mowry Shale, Muddy Sandstone, and Thermopolis Shale undivided**

Mowry Shale (Upper Cretaceous)—Dark-gray to black siliceous shale that weathers silvery gray; abundant fish scales and bentonite beds; black shale in lower part. Contact with overlying Frontier Formation is at base of last persistent sandstone on southwestern part of the map (Horn, 1963) and at base of a persistent bentonite ("Clay Spur Bentonite") in the lower black shale sequence of the Frontier Formation on the remainder of the map. Thickness 270 to 500 feet (90 to 167 m)

Muddy Sandstone (Lower Cretaceous)—Brown to gray, fine- to medium-grained sandstone, locally crossbedded. Horn (1963), Murray (1957), and Trotter (1954) considered the Muddy Sandstone a member of the Thermopolis Shale. Thickness 3 to 60 feet (1 to 20 m), thinning to the southeast

Thermopolis Shale (Lower Cretaceous)—Gray to black, soft, fissile shale. Lower dark-gray shale contains numerous dahlite concretions. Horn (1963) placed lower dark shale sequence of Mowry Shale in the Thermopolis Shale, above the Muddy Sandstone. Thickness 240 to 275 feet (80 to 92 m)

KJ — **Cloverly and Morrison formations undivided**

Cloverly Formation (Lower Cretaceous)—Divided into a lower light-gray conglomeratic sandstone overlain by brightly variegated bentonitic claystone and an upper gray to buff, massive, fine- to medium- grained sandstone, locally crossbedded and often stained red with iron. Upper sandstone is often referred to as the Greybull Sandstone Member. An upper, thin-bedded, rusty brown, limonitic sandstone and siltstone, locally referred to as the "rusty beds," is included in the Cloverly on the southwestern part of the map (Horn, 1963). Thickness 44 to 230 feet (15 to 77 m)

Morrison Formation (Upper Jurassic)—Greenish-gray to pinkish, dull variegated claystone containing some discontinuous beds of gray silty sandstone and nodular limestone. In lower part, a prominent white, crossbedded sandstone is usually present. Thickness 190 to 250 feet (63 to 83 m)

KJu — **Muddy Sandstone, Thermopolis Shale, and Cloverly, Morrison, Sundance, and Gypsum Spring formations undivided**—Formations were grouped by Bay (1969) along Bridger Creek in the southern part of the map area

Jsg — **Sundance and Gypsum Spring formations undivided**

Js — **Sundance Formation (Upper and Middle Jurassic)**—Greenish-gray glauconitic sandstone and shale overlying a middle fossiliferous limestone and shale and a basal fine-grained non-glauconitic sandstone. Thickness 140 to 330 feet (47 to 110 m)

Gypsum Spring Formation (Middle Jurassic)—Interbedded red claystone, gypsum, anhydrite, gray cherty limestone, and dolomite. Massive white gypsum with interbedded red gypsiferous claystone at base. Thins toward the south due to erosional unconformity at top. Thickness 20 to 192 feet (7 to 64 m)

JTRgc — **Gypsum Spring and Chugwater formations undivided**

Chugwater Formation (Triassic)—Includes red siltstone and shale, red sandstone, a thin laminated limestone, and thin gypsum stringers interbedded with shale near the base. The thin limestone in the upper middle section is the Alcova Limestone Member. The Chugwater is combined with the Gypsum Spring in the eastern part of the map area. Thickness 850 to 1145 feet (283 to 382 m), thickening to the south

TRcd — **Chugwater and Dinwoody formations undivided**

Dinwoody Formation (Lower Triassic)—Olive-drab to yellow, hard, dolomitic siltstone. Combined with Chugwater Formation in southwestern part of mapped area. Thickness 40 to 60 feet (13 to 20 m)

TRPg — **Goose Egg Formation (Lower Triassic and Permian)**—Reddish brown to orange mudstone and siltstone interbedded with gypsum and dolomite. Nowood Member occurs locally at base, composed of dolomite, sandstone, or conglomerate. Present in eastern half of map area. Thickness 235 to 350 feet (78 to 117 m)

Pp — **Phosphoria Formation (Permian)**—Primarily gray cherty dolomite with some limestone and phosphatic gray shale. Present in the western half of the map area. Thickness 200 to 280 feet (67 to 93 m) [Horn (1963) refers to this unit as the Park City Formation]

IPMta — **Tensleep Sandstone and Amsden Formation undivided**

Tensleep Sandstone (Pennsylvanian)—White to gray, medium- to fine-grained, massive sandstone interbedded with thin limestone and dolomite beds, especially toward the base. Sandstones are often characterized by large-scale crossbeds. Thickness 200 to 400 feet (67 to 133 m), thinning to the north

Amsden Formation (Pennsylvanian and Upper Mississippian)—Light-gray to cream, cherty dolomite interbedded with thin red shale stringers, underlain by mostly red and some green shale, with brown crossbedded sandstone (Darwin Sandstone Member) at the base. Unconformable contact with underlying Madison Limestone. Thickness 200 to 256 feet (67 to 85 m)

Mm — **Madison Limestone (Upper and Lower Mississippian)**—Gray to blue-gray limestone and dolomite; chert lenses and nodules common. Karst surface developed on top. Fossiliferous in most intervals. Thickness 250 to 500 feet (83 to 167 m)

MO — **Madison Limestone, Bighorn Dolomite, and Harding Sandstone undivided**

Bighorn Dolomite (Upper Ordovician)—Gray, massive, cliff-forming, siliceous dolomite with thin, light-gray, maroon-mottled, siliceous sandstone at base. Some zones of dolomite and sandstone are quite fossiliferous. Highly pitted weathered surface characteristic of the dolomite member. Thickness 0 to 150 feet (0 to 50 m), pinching out in the southeastern part of the map area (T43N, R85W)

Harding Sandstone (Middle Ordovician)—White and red, fine- to medium-grained siliceous sandstone. Locally contains primitive fish bones. Thickness 0 to 35 feet (0 to 12 m), pinching out in the southeastern part of the map area (T43N, R85W)

OЄ — **Gallatin Limestone, Gros Ventre Formation, and Flathead Sandstone undivided**

Gallatin Limestone (Lower Ordovician and Upper Cambrian)—Grayish-red to maroon resistant limestone interbedded with flat-pebble conglomerate and some yellowish-brown siltstone. Thickness 360 to 440 feet (120 to 147 m)

Gros Ventre Formation (Middle Cambrian)—Yellowish-green or yellowish-brown, weathering to olive-gray or maroon, glauconitic siltstone; interbedded with white to pale brown glauconitic sandstone and limestone. Flat-pebble conglomerate beds common. Landslides are quite common within this unit. Thickness 260 to 600 feet (87 to 200 m)

Flathead Sandstone (Middle Cambrian)—Yellowish-brown to maroon, medium- to coarse-grained sandstone with interbeds of green, maroon, and tan siltstone in upper part. Arkosic conglomerate near base. Sandstone crossbedded to planar bedded. Thickness 195 to 400 feet (65 to 133 m)

Precambrian metamorphic rocks

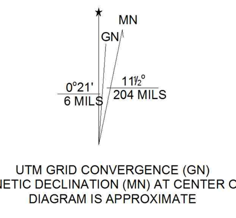
Quartz diorite, mafic, and amphibolite dikes (Early Proterozoic and Archean)—Although not dated, they are probably in the age range of dikes immediately to the north—2200 to 3000 Ma (millions of years before present) (Snyder and others, 1989)

Ugn — **Granitic gneiss (Archean)**—Layered granitic gneiss cropping out along or near the Big Trails fault system in the eastern part of map area. Dates of metamorphism 3000+ Ma (Love and Christiansen, 1985)

DISCLAIMERS

Projection: Universal Transverse Mercator (UTM), zone 13
North American Datum of 1927 (NAD 27)
10,000-meter grid ticks: UTM, zone 13
25,000-foot grid ticks: Wyoming State Plane Coordinate System, East central and West central zones

SCALE 1:100,000
Contour interval 20 meters



UTM GRID CONVERGENCE (GN)
1982 MAGNETIC DECLINATION (MN) AT CENTER OF SHEET
DIAGRAM IS APPROXIMATE

GEOLOGIC MAP OF THE NOWATER CREEK 30' x 60' QUADRANGLE, NORTHCENTRAL WYOMING

by

Alan J. Ver Ploeg, 2004, digitized and modified from Alan J. Ver Ploeg, 1992

Prepared in cooperation with the U.S. Geological Survey, National Cooperative Geologic Mapping Program, under Cooperative Agreement Number 03HQAG0097.

Digital cartography by Robin W. Lyons and Joseph M. Huss

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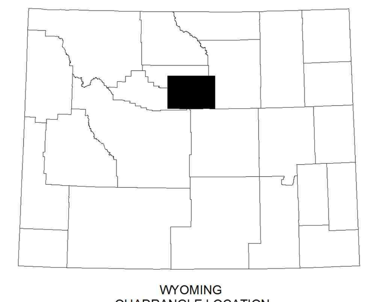
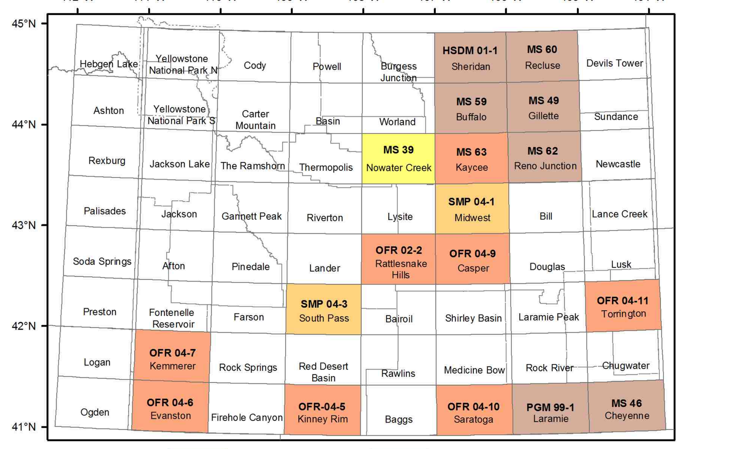


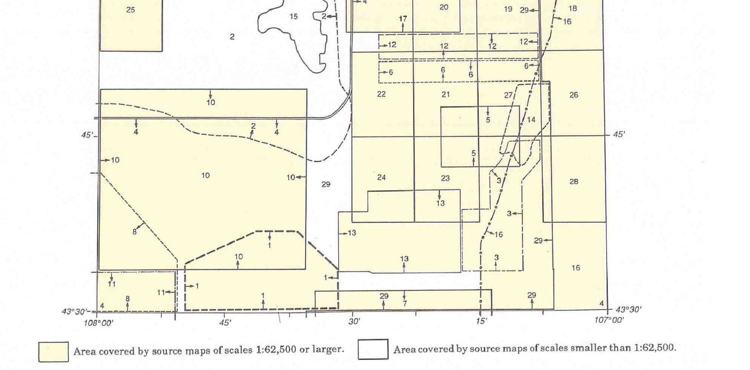
WYOMING
QUADRANGLE LOCATION



Current map
Published maps
Maps in progress
Proposed maps

INDEX TO 1:100,000-SCALE BEDROCK GEOLOGIC MAPS OF WYOMING

KEY TO ABBREVIATIONS
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).



Area covered by source maps of scales 1:62,500 or larger.
Area covered by source maps of scales smaller than 1:62,500.

INDEX OF GEOLOGICAL SOURCES

REFERENCES AND SOURCES

References and number corresponds to area on index of geologic sources; unnumbered items are general references

1. Bay, K.W., 1969, Stratigraphy of Eocene sedimentary rocks in the Lysite Mountain area, Hot Springs, Fremont, and Washakie Counties, Wyoming: Ph.D. dissertation, University of Wyoming, Laramie, 181 p., plate 1, scale 1:24,000.

2. Bown, T.M., 1979, Geology and mammalian paleontology of the Sand Creek facies, lower Willwood Formation (early Eocene), Washakie County, Wyoming: Wyoming State Geological Survey Memoir 2, 151 p., plate 1, scale 1:160,000 (approximate).

3. Buffet, R.N., 1958, Geology of the Little Canyon Creek area, Washakie County, Wyoming: M.A. thesis, University of Wyoming, Laramie, 85 p., plate 11, scale 1:20,000.

4. Darton, N.H., 1906, Geology of the Bighorn Mountains: U.S. Geological Survey Professional Paper 51, 129 p., plate 47, scale 1:250,000.

5. Dudley, J.L., 1984, Laramide folding and post-Laramide faulting in the Little Canyon Creek area, southeastern Bighorn Basin, Washakie County, Wyoming. M.S. thesis, University of Wyoming, Laramie, 71 p., figure 12, scale 1:24,000.

6. Fulkerson, D.H., 1951, Geology of a part of the west flank of the Bighorn Mountains, Wyoming: M.S. thesis, University of Wyoming, Laramie, 45 p., plate 1, scale 1:20,000 (approximate).

7. Gard, T.M., 1969, Tectonics of the Badwater uplift area, central Wyoming: Ph.D. dissertation, Pennsylvania State University, University Park, 141 p., plate 2, scale 1:48,000.

8. Gubbels, T.L., 1987, Structural and geomorphic evolution of the north flank, eastern Owl Creek Mountains, Wyoming: M.S. thesis, University of Wyoming, Laramie, 181 p., plate 13, scale 1:24,000.

9. Hoppin, R.A., Palmquist, J.C., and Williams, L.O., 1965, Control by Precambrian basement structure on the location of the Tensleep-Beaver Creek fault, Bighorn Mountains, Wyoming: Journal of Geology, v. 73, no. 1, p. 189-195, figure 1, scale 1:62,500.

10. Horn, G.H., 1963, Geology of the east Thermopolis area, Hot Springs and Washakie Counties, Wyoming: U.S. Geological Survey Oil and Gas Investigations Map OM-213, scale 1:48,000.

Hose, A.K., 1955, Geology of the Crazy Woman Creek area, Johnson County, Wyoming: U.S. Geological Survey Bulletin 1027-B, p. 33-118, plate 6, scale 1:48,000.

Love, J.D., and Christiansen, A.C., 1985, Geologic map of Wyoming: U.S. Geological Survey, 3 plates, scale 1:500,000.

Love, J.D., Christiansen, A.C., Earle, J.L., and Jones, R.W., 1978, Preliminary geologic map of the Arminto 1° x 2° Quadrangle, northern Wyoming: U.S. Geological Survey Open File Report 78-1089, scale 1:250,000.

11. Lyon, D.L., 1956, Geology of the north flank, eastern Bridger Range, Hot Springs County, Wyoming: M.A. thesis, University of Wyoming, Laramie, 95 p., plate 3, scale 1:24,000.

12. Morgan, J.K., 1951, Geology of the Otter Creek area, Washakie County, Wyoming: M.A. thesis, University of Wyoming, Laramie, 55 p., plate 1, scale 1:20,000 (approximate).

13. Murray, F.E., 1957, Geology of the Nowood area, Washakie County, Wyoming: M.A. thesis, University of Wyoming, Laramie, 115 p., plate 13, scale 1:24,000.

14. Nichols, C.E., 1965, Geology of a segment of Deep Creek fault zone, southern Bighorn Mountains, Wyoming: M.S. thesis, University of Iowa, Iowa City, 216 p., plate 1, scale 1:24,000.

15. Peper, J.D., Hill, R.H., Kulik, D.M., and Almquist, C.L., 1988, Mineral resources of the Honeycombs wilderness study area, Washakie County, Wyoming: U.S. Geological Survey Bulletin 1756-C, 17 p., figure 5, scale 1:100,000.

16. Sears, J.W., Wilson, B.D., and Wolf, R.M., (Peter Huntoon, principal investigator), 1976, Geologic map of the Paleozoic rocks along the eastern flank of the Bighorn Mountains, Wyoming: prepared by the Wyoming Water Resources Research Institute for the Office of Water Research and Technology in cooperation with the Wyoming State Engineer, scale 1:48,000.

Snyder, G.L., Hughes, D.J., Hall, R.P., and Ludwig, K.R., 1989, Distribution of Precambrian mafic intrusives penetrating some Archean rocks of western North America: U.S. Geological Survey Open File Report 89-125, 36 p.

Tappmeyer, D.M., 1974, The application of orbital imagery in the interpretation of the geology of the Nowood area, southern Bighorn Basin, Wyoming: M.S. thesis, University of Iowa, Iowa City, 65 p., plate 1, scale 1:72,000.

Tourtelot, H.A., 1953, Geology of the Badwater area, central Wyoming: U.S. Geological Survey Oil and Gas Investigations Map OM-124, 2 sheets, scale 1:48,000.

17. Trotter, J.R., 1954, Geology of the Nowood-Tensleep area, Washakie County, Wyoming: M.A. thesis, University of Wyoming, Laramie, 79 p., plate IV, scale 1:20,000 (approximate).

18. Ver Ploeg, A.J., and Greer, P.L., 1995, Geologic map of the Beartrap Meadows Quadrangle, Johnson County, Wyoming: Wyoming State Geological Survey Map Series 45, scale 1:24,000.

19. Ver Ploeg, A.J., and Greer, P.L., 1995, Geologic map of the Monument Hill Quadrangle, Johnson and Washakie Counties, Wyoming: Wyoming State Geological Survey Map Series 44, scale 1:24,000.

20. Ver Ploeg, A.J., 1990, Photogeologic map of the Big Trails NE Quadrangle, Washakie County, Wyoming: Wyoming State Geological Survey files (unpublished), scale 1:24,000.

21. Ver Ploeg, A.J., 1990, Photogeologic map of the Big Trails Quadrangle, Washakie County, Wyoming: Wyoming State Geological Survey files (unpublished), scale 1:24,000.

22. Ver Ploeg, A.J., 1990, Photogeologic map of the Indian Creek Quadrangle, Washakie County, Wyoming: Wyoming State Geological Survey files (unpublished), scale 1:24,000.

23. Ver Ploeg, A.J., 1990, Photogeologic map of the Mahogany Butte Quadrangle, Washakie County, Wyoming: Wyoming State Geological Survey files (unpublished), scale 1:24,000.

24. Ver Ploeg, A.J., 1990, Photogeologic map of the Lightning Ridge Quadrangle, Washakie County, Wyoming: Wyoming State Geological Survey files (unpublished), scale 1:24,000.

25. Ver Ploeg, A.J., 1990, Photogeologic map of the Banjo Flats West Quadrangle, Washakie County, Wyoming: Wyoming State Geological Survey files (unpublished), scale 1:24,000.

26. Ver Ploeg, A.J., and Greer, P.L., 1988, Preliminary geologic map of the Tabletop Quadrangle, Washakie and Johnson Counties, Wyoming: Wyoming State Geological Survey Open File Report 88-6, scale 1:24,000.

27. Ver Ploeg, A.J., and Greer, P.L., 1989, Preliminary geologic map of the Tallon Springs Quadrangle, Washakie and Johnson Counties, Wyoming: Wyoming State Geological Survey Open File Report 89-5, scale 1:24,000.

28. Ver Ploeg, A.J., and Greer, P.L., 1989, Preliminary geologic map of the Turk Springs Quadrangle, Washakie and Johnson Counties, Wyoming: Wyoming State Geological Survey Open File Report 89-6, scale 1:24,000.

Ver Ploeg, A.J., 1992, Geologic map of the Nowater Creek 30' x 60' Quadrangle, north-central Wyoming: Wyoming State Geological Survey Map Series 39, scale 1:100,000.

29. Weitz, J.L., and Love, J.D., 1952, Geologic map of the southern Bighorn Basin, Wyoming, in Southern Bighorn Basin: Wyoming Geological Association 7th Annual Field Conference Guidebook, unnumbered map, scale 1:187,500.