WYOMING STATE GEOLOGICAL SURVEY
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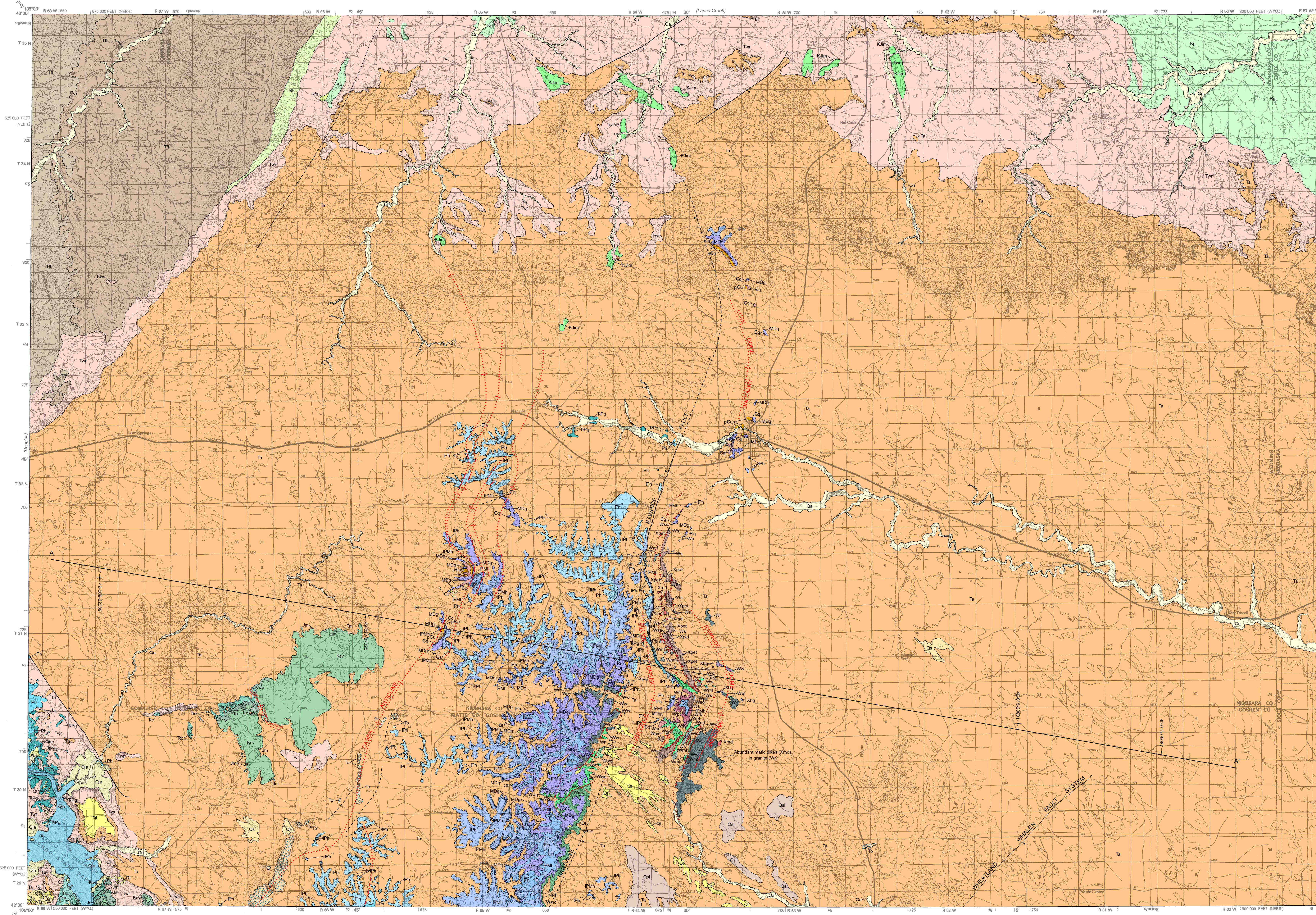
Laramie, Wyoming

Geology - Interpreting the past - Providing for the future

Prepared in cooperation with the
U.S. GEOLOGICAL SURVEY

MAP SERIES 82
Lusk 1:100,000 - scale Bedrock Geologic Map
January, 2011

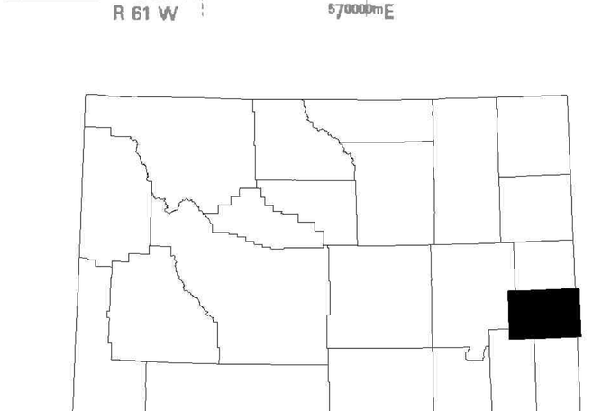


Lusk, Wyoming base map compiled from USGS 1:24,000-scale topographic maps dated 1949-1981. Partially revised from aerial photographs taken 1979 and other source data. Revised information not field checked. Map edited 1982

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 (SPCS), West and East Central Zone and Nebraska SPCS

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

SCALE 1:100,000
Contour interval 20 meters



WYOMING QUADRANGLE LOCATION

Digital cartography by Thomas E. Ver Ploeg, James E. Stafford, and J. Fred McLaughlin
Map design and editing by Richard W. Jones

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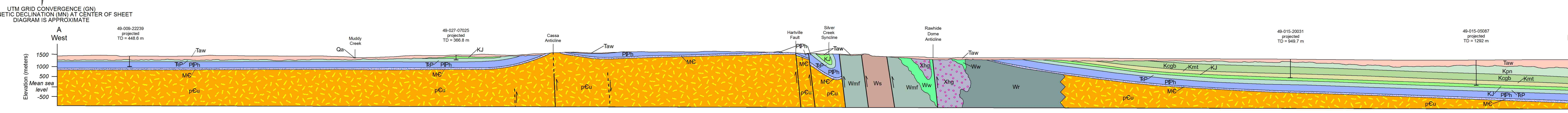


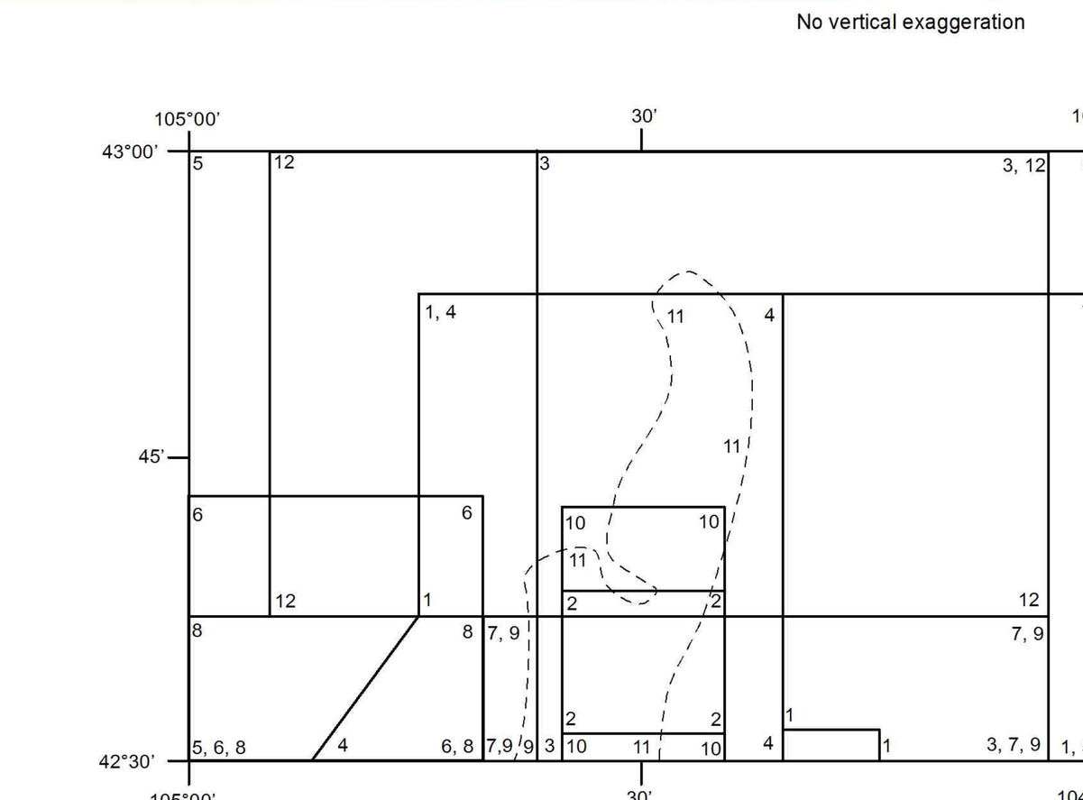
WEST TO EAST CROSS SECTION A - A'

No vertical exaggeration

GEOLOGIC MAP OF THE LUSK 30' x 60' QUADRANGLE, NIOBRARA, GOSHEN, CONVERSE, AND PLATTE COUNTIES, WYOMING, AND SIOUX COUNTY, NEBRASKA

compiled and mapped by

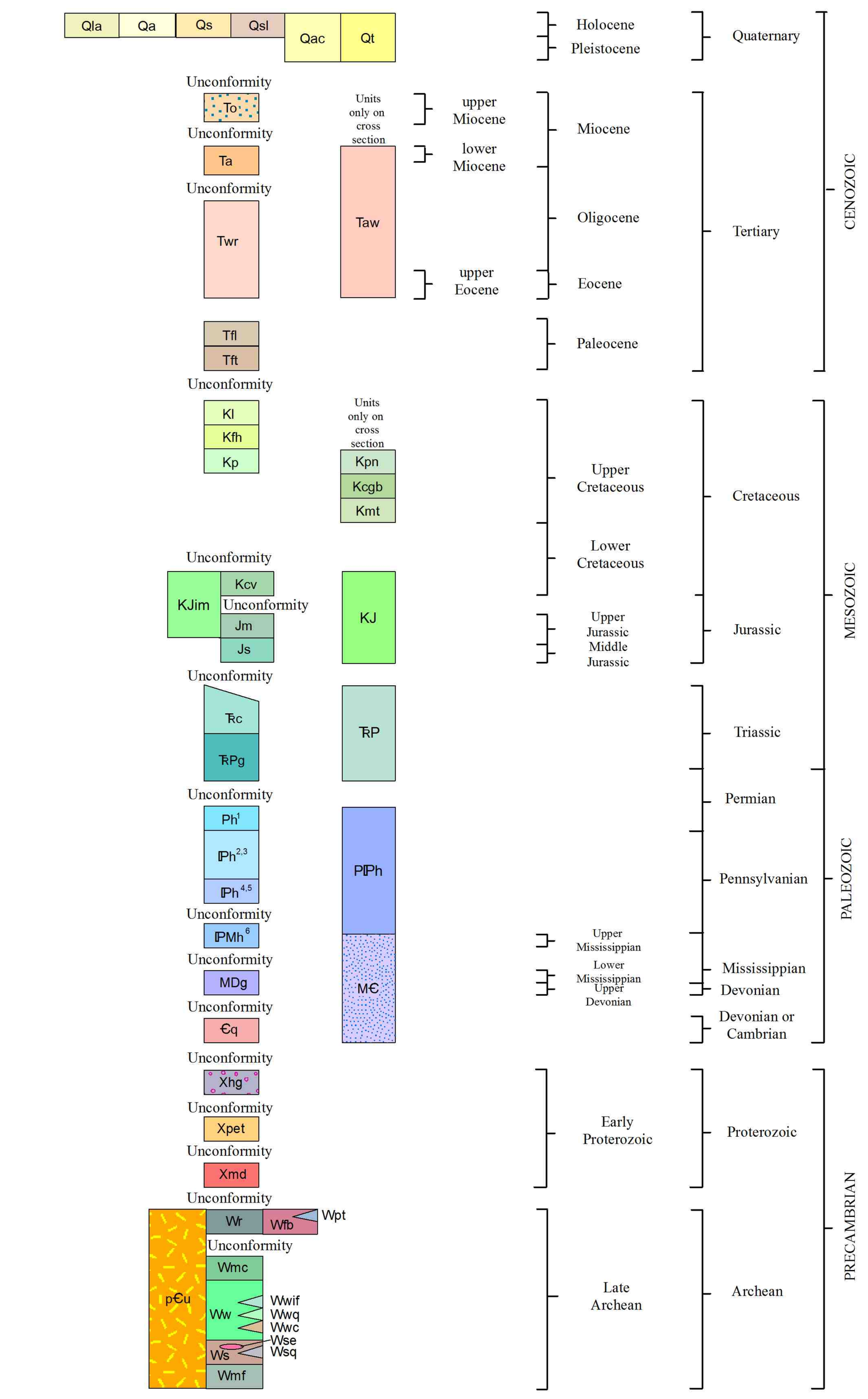
J. Fred McLaughlin, James E. Stafford, and Ray E. Harris
2011



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

EXPLANATION

CORRELATION OF MAP UNITS



MAP SYMBOLS

Formation contact

Fault—Dashed where inferred (approximately located); dotted where projected beneath younger units; ball and bar on downthrown block. The Hartville, Wheatland-Whalen, and Rawhide faults appear to be Laramide or later normal or high-angle reverse faults reactivated on Precambrian thrust faults and may displace most or all of the Phanerozoic sedimentary rock sequence

Thrust fault of Early Proterozoic age—Dashed where inferred; dotted where projected beneath younger units; sawteeth on upper (tectonically higher) plate. From Sims and Day (1999) and Day and others (1999). These faults formed during the suturing and accretion of Precambrian terranes during Early Proterozoic tectonism, and some were likely reactivated during the Laramide Orogeny

Anticline—Dashed where inferred (approximately located), dotted where projected beneath younger units

Syncline—Dashed where inferred (approximately located), dotted where projected beneath younger units

A A' **Line of cross section**

49-015-05087 **Drill hole**—Used to construct cross section; API number and total depth (T.D.) of well shown on cross section

DESCRIPTION OF GEOLOGIC UNITS

Quaternary surficial deposits

Qla **Lacustrine deposits (Holocene)**—Silt, fine-grained sand, and reworked sediments originally deposited in and now associated with Glendo Reservoir

Qa **Alluvial deposits (Holocene)**—Silt, fine-grained sand, and some gravel in the present flood plains, point bars, and islands of the principal streams

Qs **Dune sand (Holocene)**—Fine-grained, windblown sands

Qsl **Sand and loess (Holocene)**—Fine-grained residual sand and loess; thickness from 0 to 40 feet (0 to 12 m)

Qac **Alluvium and colluvium (Holocene/Pleistocene)**—Unconsolidated to poorly consolidated clay, silt, sand, and gravel; occurs only near Glendo Reservoir; thickness generally 0 to 50 feet (0 to 15 m)

Qt **Terrace gravels (Holocene/Pleistocene)**—Pebble, cobble and boulder deposits containing some silt, fine-grained sand, lenses of bentonitic clay, and locally some ash beds

Tertiary sedimentary rocks

To **Ogallala Formation (upper Miocene)**—Fine to coarse-grained, light-gray to greenish, yellowish, and orange-gray sandstone interbedded and interfingered in upper part with conglomerate, claystone, and freshwater limestone; white to dark-gray vitric tuff beds near top; lower part has hard "pipy" calcareous sandstone concretions; thickness 0 to 400 feet (0 to 120 m)

Taw **Arikaree and White River Formations, undivided**—On cross section only

Ta **Arikaree Formation (Miocene/Oligocene)**—Light-gray to buff fine-grained poorly bedded sandstone containing abundant magnetite grains; some siltstone, limestone, and tuff; lenticular conglomerate near base; thickness 0 to 705 feet (0 to 215 m)

Twr **White River Formation (Oligocene and upper Eocene)**—White to pale pink blocky tuffaceous, bentonitic claystone and lenticular arkosic conglomerate with lenses of thin gray sandstone; thickness 0 to 450 feet (0 to 137 m). Age of lower part has been re-assigned to the Eocene based on redefinition of the Oligocene-Eocene boundary (Lillegraven, 1993)

Fort Union Formation (Paleocene)

Tfl **Lebo Member**—Fine to coarse-grained drab to gray sandstone, finely conglomeratic in part, interbedded with drab siltstone, claystone, shale, and thin coal beds. Includes rocks equivalent to the Tongue River Member farther north. Thickness 0 to 2,490 feet (0 to 759 m)

Tft **Tullock Member**—Has a drab to gray appearance and contains massive light-gray sand-stones, whereas the Lebo Member is darker colored and contains more shale and claystone. Thickness 0 to 1,510 feet (0 to 460 m)

Upper Cretaceous sedimentary rocks

Kl **Lance Formation**—Gray shale and drab massive lenticular concretionary sandstone; many thin coal beds in lower half; crops out only in northwest part of quadrangle. Only upper part exposed on quadrangle; thickness 2,000 to 2,490 feet (610 to 759 m) where exposed north of quadrangle

Kfh **Fox Hills Sandstone**—White to light-gray sandstone and gray sandy shale containing marine fossils; only lower part exposed; crops out only in northwest part of quadrangle. Thickness 148 to 197 feet (45 to 60 m)

Kp **Pierre Shale**—Dark-gray to black concretionary marine shale. Includes Red Bird Silty Member in middle part and Sharon Springs Member near base; many bentonite beds. Thickness 2,000 to 3,100 feet (610 to 940 m)

Kpn **Pierre Shale and Niobrara Formation, undivided**—On cross section only

Kcgb **Carlile Shale, Greenhorn Formation, and Belle Fourche Shale, undivided**—On cross section only; Denver Basin terminology

Upper and Lower Cretaceous sedimentary rocks

Kmt **Mowry Shale (Upper Cretaceous), Muddy Sandstone (Lower Cretaceous), and Thermopolis Shale (Lower Cretaceous), undivided**—On cross section only

Lower Cretaceous and Jurassic sedimentary rocks

KJim **Inyan Kara Group and Morrison Formation, undivided**—An extension of Black Hills nomenclature; mapped in isolated outcrops north of the Niobrara River where individual formations could not be determined

Inyan Kara Group (Lower Cretaceous)—Lithology and thickness similar to Cloverly Formation (below)

Morrison Formation (Upper Jurassic)—See description below

KJ **Cloverly, Morrison, and Sundance Formations, undivided**—On cross section only

Kcv **Cloverly Formation (Lower Cretaceous)**—A tripartite unit consisting of a basal tan to white, coarse-grained sandstone and chert pebble conglomerate, locally cross-bedded; variegated buff and purple claystones interbedded with thin black shale beds in the middle; and an upper gray to buff to brown, fine to coarse-grained, resistant slabby sandstone and siltstone, locally referred to as the "Rusty Beds." Thickness approximately 100 to 300 feet (30 to 90 m)

Jm **Morrison Formation (Upper Jurassic)**—Dull, variegated, bentonitic claystone, fine-grained fresh-water limestone, with layers, beds, and lenses of tan to gray sandstone. Limestone beds containing cherty algal beds are present near the top, and numerous thin beds of gray, fine-grained, poorly bedded, clayey fresh-water limestone occur in the lower part of the formation. Claystone is dull green, pink, and purple, and is hard and siliceous. The top of the Morrison is marked by a sharp lithologic break and an erosional unconformity. The base is placed at the bottom of a yellowish-buff sandstone, where a conspicuous erosional break occurs with the underlying Sundance Formation. Thickness 130 to 220 feet (40 to 67 m)

Js **Sundance Formation (Middle and Upper Jurassic)**—Divided into two informal units. The upper Sundance consists of glauconitic green shale and shaly sandstone, with a gray, glauconitic, basal sandstone up to 30 feet (9 m) thick; thickness of upper unit is 50 to 120 feet (15 to 37 m). The lower Sundance is fine-grained, non-glauconitic, limy sandstone, commonly red near the top, with persistent shaly and silty zones near the base; shale zones are purple, green, and gray; siltstone zones are olive drab; thickness of lower unit is 140 to 220 feet (43 to 67 m). Total thickness of Sundance is 190 to 340 feet (58 to 104 m)

Triassic sedimentary rocks

TRc **Chugwater Formation (Lower Triassic)**—Red shale and siltstone with some red sandstone and shale. The lower part includes gypsum laminae along with some anhydrite, though neither are bedded; upper part is more limey and a major unconformity exists at the top of the formation; thickness 150 to 435 feet (46 to 133 m)

Mesozoic and Paleozoic sedimentary rocks

TRP **Chugwater and Goose Egg Formations, undivided**—On cross section only

TRPg **Goose Egg Formation (Lower Triassic and Permian)**—Interbedded red to ocher shale and siltstone, thin limestone, limestone breccias, and gypsum beds; thickness 195 to 245 feet (59 to 105 m)

Paleozoic sedimentary rocks

PIPh **Hartville Formation, undivided (Permian and Pennsylvanian)**—On cross section only

Hartville Formation—Subdivided into six informal divisions, numbered from 1 (stratigraphically highest) to 6 (stratigraphically lowest). Some divisions are combined for ease in mapping

Ph^{1} **Division 1 (Permian)**—Red, silty shale and siltstone, red eolian sandstone, and limestone; forms ledges and slopes; thickness 0 to 300 feet (0 to 91 m)

$IPh^{2,3}$ **Divisions 2 and 3 (Pennsylvanian)**—Interbedded gray limestone; buff to chalky white limestone and dolomite; pink dolomite; buff eolian sandstone; gray, red, and maroon siltstone and claystone; and thin black shale. Brachiopods are common in the limestone and dolomite layers; forms ledged slopes and cliffs; thickness 0 to 300 feet (0 to 91 m)

$IPh^{4,5}$ **Divisions 4 and 5 (Pennsylvanian)**—Interbedded maroon, pink, and gray siltstone and claystone; gray, brown, and buff limestone; pink dolomite; and thin gray sandstone beds. Forms smooth slopes with limestone ledges; thickness 0 to 250 feet (0 to 76 m)

$IPMh^{6}$ **Division 6 (Pennsylvanian and Upper Mississippian)**—Well-indurated maroon to red orthoquartzite that forms cliffs and rocky knolls. Deposited on a well-developed karst surface, and fills sinkholes and caverns in limestone of the underlying Guernsey Formation. Sporadically exposed and is absent in many areas within the quadrangle. This unit is equivalent to the Darwin Sandstone Member of the Hartville as described by Sando and Sandberg (1987). Thickness 0 to 120 feet (0 to 37 m)

MЄ **Mississippian, Devonian, and Cambrian (?) rocks, undifferentiated**—On cross section only

MDg **Guernsey Formation (Lower Mississippian and Upper Devonian)**—Subdivided into an upper limestone unit of Early Mississippian age and a lower unit of Devonian age. The upper Guernsey consists of gray, cherty, coarsely crystalline, coarsely bedded, hard limestone; the chert has variety of colors and there are predominant dark-brown quartzitic layers and nodules in this unit; average thickness approximately 135 feet (41 m). The surface of the upper unit is highly irregular, with many local variations (marked by general thickening of formation toward the northwest). The lower unit is purple to gray dolomite, thin-bedded, slabby, fine-grained, hard, brittle, and silty, interbedded with hard, dolomitic purple shale and siltstone; thickness approximately 65 feet (20 m). Approximately 4 feet (1.2 m) of pink arkose with abundant feldspar and white quartz grains and pebbles occurs at base of lower unit and rests on Precambrian rocks. Total thickness exposed in the Hartville area is 140 to 260 feet (43 to 79 m). [Note: in places where this basal arkose and cross-bedded orthoquartzite occurs, it is mapped as Devonian or Cambrian quartzite (Єq) as described below.]

Єq **Devonian (?) or Cambrian (?) quartzite**—The basal arkosic sandstone of the Guernsey was previously interpreted as Cambrian in age, but Sando and Sandberg (1987) reinterpreted this as the Fremont Canyon Sandstone (new name) and assigned it to the Upper Devonian. These authors considered the Guernsey Formation a superfluous name and divided it instead into the Madison Limestone (Mississippian in age) at the top, the Englewood Formation in the middle, and the Fremont Canyon Sandstone (this unit, Devonian in age) at the base.

Quartzite (Devonian or Cambrian)—Gray to red to cream-colored, coarse-grained, cross-bedded orthoquartzite found in lenses locally throughout the area. Possibly equivalent to the Deadwood Quartzite/Flathead Sandstone (Cambrian) or based on work by Sando and Sandberg (1987), the lowermost part of the Englewood Formation and the Fremont Canyon Sandstone

Early Proterozoic rocks (2,500 to 1,600 Ma)

Xhg **Gneissic phase of Haystack Range Granite**—Granite deformed to gneiss in aureole surrounding buried granite dome (modified from Sims and Day, 1999)

Xpet **Tourmaline-bearing granite pegmatite**—Light, coarse-grained, granitic pegmatite containing dark, iron-rich tourmaline (modified from Sims and Day, 1999)

Xmd **Metadiabase**—Dark- green to black, granular, medium-grained horneblende-plagioclase-quartz metadiabase and amphibolite (modified from Sims and Day, 1999)

Late Archean rocks (2,900 to 2,500 Ma)

Wr **Rawhide Buttes Granite**—Pink, red, or gray, medium-to coarse-grained foliated granite. Locally gneissic with abundant muscovite and sillimanite (modified from Sims and Day, 1999). Rb-Sr whole-rock isochron age of 2.66 Ga (Day and others, 1999)

Wfb **Flattop Butte Granite**—Pink to red, deformed (foliated to gneissic) granite (modified from Sims and Day, 1999). U-Pb zircon age of 2.66 Ga (K.R. Chamberlain, 1997 oral comm.; cited in Sims and Day, 1999)

Wpt **Tourmaline-bearing granite pegmatite**—Light, coarse-grained, granitic pegmatite containing dark, iron-rich tourmaline interpreted to be related to Flattop Butte Granite emplacement (modified from Sims and Day, 1999)

Whalen Group—Includes the Muskrat Canyon Metabasalt and Wildcat Hills Formation

Wmc **Muskrat Canyon Metabasalt**—Dark-green, fine-grained actinolite-biotite-chlorite schist; locally includes pillows (modified from Sims and Day, 1999)

Ww **Wildcat Hills Formation**—White to gray dolomite and marble. Includes stromatolites, tremolite marble, and dolomitic marble (modified from Sims and Day, 1999)

Wwif **Banded iron-formation**—Banded chert and iron formation; separately mapped unit within the Wildcat Hills Formation (modified from Sims and Day, 1999)

Wwq **Quartzite**—Gray to red cross-bedded quartzite; separately mapped unit within the Wildcat Hills Formation (modified from Sims and Day, 1999)

Wwc **Conglomerate**—Quartz pebble conglomerate; separately mapped unit within the Wildcat Hills Formation (modified from Sims and Day, 1999)

Ws **Silver Springs Formation**—Dark-gray greywacke and argillite with chlorite and local garnets. Laterally gradational to iron-rich sediments including iron-formation and hematitic iron ore. East of the Hartville fault, formation is a massive micaceous schist with garnet and sillimanite (modified from Sims and Day, 1999)

Wse **Siliceous exhalite**—Thin, horizontal volcanic unit within the Silver Springs Formation (modified from Sims and Day, 1999)

Wsq **Quartzite**—Gray to pinkish gray quartzite unit within the Silver Springs Formation (modified from Sims and Day, 1999)

Wmf **Mother Featherlegs Metabasalt**—Dark- to greenish-gray, either massive or layered metabasalt with local pillows

pЄu **Precambrian rocks, undifferentiated**—Undifferentiated granites, metasedimentary, and metavolcanic rocks including quartzite, hornblende gneiss, foliated marbles, and calc-silicate rocks

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(Numbers refer to INDEX TO SOURCES OF GEOLOGIC MAPPING)

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