Kn Niobrara Formation—Dark-gray to yellowish-buff marine shale and chalky, soft, white limestone; highly seleniferous. Equivalent to the lower Cody Shale and used in the area southwest of Casper Mountain and south and east of the North Platte River. Thickness about 700 feet (205 m) (description and thickness modified from Love and others, 1980).

Kf Frontier Formation—Dark-gray and black shales with thin concretionary sandstone. Wall Creek Sandstone Member on top. Thickness 590 to 705 feet (180 to 215 m) (description and thickness modified from Love and others, 1980).

Upper and Lower Cretaceous sedimentary rocks

DESCRIPTION OF MAP UNITS

Qa Alluvial deposits (Holocene)—Unconsolidated and poorly consolidated clay, silt, sand,

Landslide deposits (Holocene/Pleistocene)—Blocks of bedrock, surficial materials, or

Qac Mixed alluvium and colluvium (Holocene/Pleistocene)—Sand, silt, clay, and gravel

Qsw Slope wash (Quaternary)—Pebbles, cobble, and gravels amidst a variegated matrix.

Qtg Terrace deposits (Holocene/Pleistocene)—Unconsolidated (partially consolidated locally)

Qs Windblown sand (Holocene/Pleistocene)—Primarily gray quartz sand; includes active

To Ogallala Formation (Upper Miocene)—Fine- to coarse-grained, light- to greenish-

Ta Arikaree Formation (Lower Miocene/Oligocene)—Light-colored (tan to gray to white),

Tmoc Miocene and Oligocene conglomerate—Mostly light-gray conglomerate and gray

Twr White River Formation (Oligocene)—White to pale pink blocky tuffaceous, bentonitic

Tw Wasatch Formation (Eocene)—Lenticular interbeds of gray to light-brown, fine- to

dark- to light-gray or brown or greenish-gray shale, claystone, and siltstone.

Subbituminous coal beds, lignite beds, and carbonaceous shales occur locally.

Thicknesses of over 2,400 feet (730 m) in the Powder River Basin, but only the

Tftl Tongue River and Lebo Members undivided—Yellowish-gray sandstone and siltstone;

ranges from about 1,725 to 2,825 feet (525 to 861 m) (Denson and others, 1995).

drab appearance and massive sandstone units. Interbedded tan to buff sandstone, siltstone, dark brown and gray carbonaceous shale, and thin coal beds. Thickness 750 to

KI Lance Formation—In Powder River Basin consists of gray shale and drab brown, massive

Kfh Fox Hills Sandstone—Brownish gray to yellow-brown sandstone interbedded with

Kmy Mesaverde Formation—Teapot Sandstone Member, white, at top; underlain by unnamed

Kc Cody Shale—Dark-gray calcareous, fossiliferous marine shale interbedded with light-gray

(description and thickness modified from Love and others, 1980).

1,850 feet (229 to 564 m) (description and thicknesses from Denson and others, 1995).

lenticular, concretionary sandstone; thin coal beds in lower half. Thickness 1,000 to 2,500

siltstone and dark sandy shale containing marine fossils. The sandstone is characterized

as a coarsening upward sequence. Thickness approximately 150 to 200 feet (45 to 60 m)

gray sandstone, shale, and coal member; nonmarine gray Parkman Sandstone Member at

base. Parkman Sandstone commonly contains brown-weathering calcareous concretions.

Thickness about 600 to 1,200 feet (180 to 365 m) (description and thickness modified

fine-grained sandstone, with numerous bentonite beds in the upper two-thirds of the

formation. Septarian concretions common throughout the shale units. An upper,

glauconitic, fine-grained shaly sandstone (Shannon Sandstone Member) occurs about

1,000 feet (300 m) below the top of the formation. The Sussex Sandstone Member

occurs approximately 400 feet (120 m) above the Shannon. Thickness about 300 to 4,500

MAP SYMBOLS

movement. No indication on fault trace indicates undetermined motion. Dashed where

concealed by surficial deposits. Asymmetric anticlines are shown by shorter arrow on

Fault—Bar and ball on downthrown block; arrows indicate relative direction of oblique-slip

Thrust fault—Sawteeth on upthrown block. Dashed where approximately located and dotted

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

CORRELATION OF MAP UNITS

INDEX TO GEOLOGIC MAPPING

(numbers are those listed in the sources of geologic data)

approximately located and dotted where concealed

feet (915 to 1,370 m) (description and thickness modified from Love and others, 1980).

feet (300 to 760 m) (description and thickness modified from Love and others, 1980).

Tft Tullock Member—Distinguished from the conformably overlying Lebo Member by its

coal beds and carbonaceous shales; and, locally, thin lenses of conglomerate. Thickness

lowermost part exposed on this quadrangle (description based on Kohout, 1957).

beds of pebble and cobble gravels and lenses of silt and sand. Consist of uncorrelated

terraces which occur along present drainages, a few feet (0.6 m) to over 100 feet (30 m)

and inactive (stabilized) sand dunes trending southwest to northeast, mainly in the area

yellowish-, and orange-gray sandstone interbedded and interfingered in the upper part

with conglomerate, claystone, and freshwater limestone; white to dark-gray vitric tuff beds near the top. Lower part has hard "pipy" calcareous sandtone concretions. Thickness

poorly to well cemented, variably tuffaceous siltstone and sandstone interbedded with

thin claystone and conglomerate. The formation also contains local limestone and

volcanic ash beds. Thickness 0 to 705 feet (0 to 215 m). Only present in the Denver

channel sandstone interbedded with blocky brown and gray claystone and orange-gray

siltstone. Claystone is like that underlying White River Formation (Twr). Clasts in the

conglomerate are Paleozoic and Precambrian rocks, mostly in a gray calcareous

claystone and lenticular arkosic conglomerate with lenses of thin gray sandstone.

terrace deposits in many of the stream valleys.

Result of mass wasting on steep slopes.

above modern flood plains.

northeast of Douglas.

0 to 400 feet (0 to 122 m).

sandstone matrix. Thickness 0 to 490 feet.

Thickness 0 to 1,150 feet (0 to 350 m).

Fort Union Formation (Paleocene)

Upper Cretaceous sedimentary rocks

from Love and others, 1980).

---- Formation contact

where concealed

especially those weakened by water and undercutting.

and gravel, mainly in channel or meander belt of creeks and rivers. Includes lowest level

loose slope debris that have fallen, slumped, or flowed down moderate to steep slopes,

deposited mainly along intermittent streams and rivers; includes slope wash and smaller

alluvial fan deposits that coalesce with alluvium and youngest low-level terrace deposits.

Quaternary surficial deposits

Kmt Mowry Shale, Muddy Sandstone, and Thermopolis Shale undivided

EXPLANATION

Mowry Shale (Upper Cretaceous)—Hard, dark gray, siliceous shale that weathers silver gray and contains thin bentonite beds and abundant fish scales. Lower unit is dark gray to black nonresistant shale with thin interbedded white fine-grained ledge-forming sandstone near the base, grading into the underlying Muddy Sandstone. Contact with overlying Frontier Formation is at the base of the persistent "Clay Spur Bentonite." Thickness approximately 350 feet (107 m) (description and thickness modified from Ver

Muddy Sandstone (Lower Cretaceous)—Tan to gray fine- to medium-grained friable to well lithified sandstone that is 5 to 30 feet (1.5 to 9 m) thick. Easily identified by its drab color and grains of black minerals (description and thickness modified from Ver Ploeg,

Thermopolis Shale (Lower Cretaceous)—Dark gray to black soft fissile shale with some interbedded bentonite layers. Ironstone concretions appear in the lower portion of the formation. Thickness 160 to 200 feet (49 to 60 m) (description and thickness modified from Ver Ploeg, 2004b).

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) (description and thickness modified from Love and others,

Jurassic sedimentary rocks

Jm Morrison Formation (Upper Jurassic)—Pale-green, olive-green, blue-green to maroon and chalky, white, variegated calcareous and bentonitic claystones interbedded with lightgray, fine-grained, friable, cross-bedded silty sandstones. Dinosaur bones and bone fragments are common in the upper part of the section. Thickness approximately 100 to 300 feet (30 to 90 m) (description and thickness modified from Love and others, 1980).

Js Sundance Formation (Upper and Middle Jurassic)—Upper part is gray to greenishgray glauconitic shale with an upper layer consisting of slabby shale and calcareous sandstone that weathers brown and is slightly glauconitic. Middle part is red and gray nonglauconitic sandstone and shale and thin gypsum and limestone beds. Lower part is thickbedded gray to pink sandstone. Thickness approximately 550 feet (170 m) (description and thickness modified from Love and others, 1980).

Triassic and Permian sedimentary rocks Rc | Chugwater Group (Upper and Lower Triassic)—Includes, from top to bottom, Popo Agie Formation, Crow Mountain Sandstone, Alcova Limestone, and Red Peak Formation. Popo Agie includes lower limestone unit with upper ocher and purple mudstones; Crow Mountain is reddish-orange sandstone, locally referred to as the Jelm Formation; Alcova is purplish gray slabby algal limestone; Red Peak is red shale,

305 m) (description and thickness modified from Love and others, 1980). RPg Goose Egg Formation (Triassic and Permian)—Dark-red to reddish-orange shale and siltstone with interbedded gypsum, algal limestone, and dolomite, mainly in the lower part. Thickness approximately 200 to 300 feet (60 to 90 m) (description and thickness modified from Love and others, 1980).

siltstone, and fine-grained sandstone. Thickness approximately 300 to 1,000 feet (90 to

Permian, Pennsylvanian, Mississippian, and Cambrian sedimentary rocks

PPc Casper Formation (Lower Permian and Upper and Middle Pennsylvanian)— Alternating thicker red and white sandstone and thinner gray to pink, hard, persistent limestone, with red shale and siltstone. The sandstone is highly cross-bedded with festoon cross-bedding common. The limestone is fossiliferous with brachiopods and fusilinids. Thickness approximately 600 to 1,100 feet (180 to 335 m) (thickness from Love and others, 1979).

Ph¹ Hartville Formation, Division 1 (Permian)—Red, silty shale and siltstone, red aeolian sandstone, and limestone. Forms ledges and slopes. Thickness 0 to 300 feet (0 to 91 m).

Ph²⁻³ Hartville Formation, Divisions 2 and 3 (Pennsylvanian)—Interbedded gray limestone, buff to chalky white limestone and dolomite, pink dolomite, buff aeolian sandstone, gray, red, and maroon silt and claystones, and thin black shale's. Brachiopods are common in the limestone and dolomite layers. Forms ledged slopes and cliffs. Thickness 0 to 300 feet (0 to 91 m).

PMh⁴⁶Hartville Formation, Divisions 4, 5, and 6 (Pennsylvanian and Upper Mississippian)—Hartville 4-5 is interbedded maroon, pink, and grey siltstones and claystones, gray, brown, and buff limestone, pink dolomite, and thin gray sandstones. Forms smooth slopes with limestone ledges. Thickness 0 to 250 feet. Hartville 6 is well indurated maroon to red orthoguartzite. Forms cliffs and rocky knolls. Deposited on a well developed karst surface, and fills sinkholes and caverns in the underlying Madison limestone. Thickness 0 to 120 feet (0 to 37 m).

REFERENCES CITED AND SOURCES OF GEOLOGIC DATA

Anticline—Trace of axial plane and direction of plunge compiled from source mapping or determined by field dip measurements and by photo interpretation. Dotted where axis is Barlow, J.A., Jr., 1950, Geology of the La Prele Creek-Boxelder Creek area, Converse County, Wyoming:

I-1724, scale 1:24,000.

M.S. thesis, University of Wyoming, Laramie, 49p., scale 1:21,120. Clarey, K., 1986, Unpublished geologic mapping of the Laprele Reservoir and Sheep Mountain area: University of Wyoming student project.

De Bruin, R.H., 1985, Geologic map of Converse County, Wyoming: Wyoming State Geological Survey Open File Report (OFR) 85-13, scale 1:250,000.

Denson, N.M., and Botinelly, T., 1949, Geology of the Hartville uplift, eastern Wyoming: U.S. Geological

basin, Converse, Niobrara, and Natrona Counties, Wyoming: U.S. Geological Survey, Miscellaneous

Survey Oil and Gas Investigations Map OM-102, scale 1:48,000. Denson, N.M., Gibson, M.L., and Sims, G.L., 1995, Geologic map showing thickness of the Upper Cretaceous Pierre Shale in the south half of the Powder River Basin, northeastern Wyoming and

adjacent areas: U.S. Geological Survey Miscellaneous Investigations Series Map I-2380-B, scale Denson, N.M., and Horn, G.H., 1975, Geologic and structure map of the southern part of the Powder River

Investigations Series Map I-877, scale 1:125,000. Dobbin, C.E., Kramer, W.B., and Horn, G.H., 1957, Geologic and structure map of the southeastern part of the Powder River basin, Wyoming: U.S. Geological Survey, Oil and Gas Investigations Map OM-

Drwenski, V.R., 1952, Geology of the Boxelder-Mormon Canyon area, Converse County, Wyoming: M.S. thesis, University of Wyoming, Laramie, 67p., scale 1:24,000.

Gable, D.J., 1987, Geologic maps of the greenstone-granite areas, northern Laramie Mountains, Converse and Natrona Counties, Wyoming: U.S. Geological Survey, Miscellaneous Investigations Series Map

Gregory, R.W., and Ver Ploeg, A.J., 2006, Preliminary geologic map of the Bill 30' x 60' Quadrangle: Wyoming State Geological Survey Open File Report (OFR) 06-7, scale 1:100,000.

Memf Madison Limestone and Cambrian rocks undivided—Sando and Sandberg (1987) revised the age and terminology of the Cambrian sequence to Mississippian and Devonian Englewood Formation and Devonian Fremont Canyon Sandstone.

Unconformity

Mm Madison Limestone (Upper and Lower Mississippian)—Alternating units of light-tan to gray cherty limestone and dolomite. Upper part bluish-gray limestone with karst surface at the top. Lower part mainly dolomite and dolomitic limestone. The entire formation is fossiliferous; spiriferoid brachiopods and solitary tetracorals being the most common. Sando and Sandberg (1987) included the lowermost part of the Madison Limestone in their Mississippian and Devonian Englewood Formation. Thickness ranges from 100 to 400 feet (30 to 120 m), thinning toward the south (thickness modified from Love and

Ef Flathead Sandstone (Middle Cambrian or Mississippian and Devonian)—Reddishgray, tan, and light-brown, medium to coarse-grained quartz sandstone in beds, locally conglomeratic and cross-bedded. Thin interbeds of green, maroon, and tan siltstone, mainly in the upper part; arkosic conglomerate in the lower part. Sando and Sandberg (1987) divided this sequence into Mississippian and Devonian Englewood Formation and Devonian Fremont Canyon Sandstone. Thickness 15 to 200 feet (5 to 60 m) (description and thickness modified from Gable and others, 1988 and Sando and Sandberg, 1987).

Precambrian crystalline rocks

Intrusive rocks

pEd Diabase dikes—(Proterozoic and Archean)—A fine-to medium-grained, dark-gray to black rock that weathers yellow-brown to brown. Diabase dikes are up to 5 m wide, and 1 km long. Age is uncertain, though they cut the Precambrian host rock. They may be as old as 2,600 Ma (Peterman and Hildreth, 1978), or as young as 740 Ma (Condie, 1976). Description modified from Gable and others (1987).

Aa Amphibolite (Archean)—Medium- to coarse-grained, greenish-gray to black amphibole that varies from poorly foliated to massive. Amphibolite occurs as near vertical dikes 3m wide, or less, and rarely over a kilometer long. Ages vary, but all crosscut granites.

Description modified from Gable and others (1987). Ap Pegmatite (Archean)—Light colored, very coarse grained rock that varies from feldsparrich to predominantly quartz. Forms as veins in granite (Ag), in granite gneiss (Agn), and in felsic gneiss (Agf), and as lenses in hornblende gneiss (Agh). Weathers into boulder

outcrops. Description modified from Gable and others (1987).

Ag Granite (Archean)—Granite of the Laramie batholith is massive, leucocratic, pinkish-red bright-red medium-grained to very coarse-grained, nonfoliated, granite with a profusion feldspar-rich pegmatites, some quartz veins, and numerous amphibolite and diabase

Description modified from Gable and others (1987). Agn Granite gneiss (Archean)—Foliated granite: predominantly medium-grained, leucocratic, pinkish-buff rock the weathers brownish gray. Some areas contain sillimanite, garnet, and some microcline megacrysts. Commonly more mafic than local granite (Ag). Description modified from Gable and others (1987).

Agf Felsic gneiss (Archean)—Gray to grayish white mottled, fine- to coarse-grained, foliated elsic gneiss. Typically weathers buff to pinkish-gray, lighter weathering color corresponds to coarser grained material. Felsic gneiss is found only in the Spring Canyon area (due west of LaPrele Reservoir) as dikes and small outcrops that crosscut hornblende gneiss (Agh). Description modified from Gable and others (1987).

Au Ultramafic rocks and serpentintite (Archean)—Ultramafics are generally medium to coarse-grained, dark gray, weathering to dark brown, and commonly altered to serpentinite or to rock containing anthophyllite and cordierite. Occurs as lenses that are as much as 500 m long and 250 m wide. Serpentinite is emerald-green to dark greenishgray, massive to thinly-layered crisscrossed by thin veins of magnetite, chromite, and asbestos minerals. Descriptions modified from Gable and others (1987).

Layered rocks

Agg Garnet gneiss (Archean)—Light colored, garnet-bearing, quartz-feldspar-rich gneiss that is well foliated; varies from fine- to coarse-grained rock; found in the Mormon Canyon and Box Elder Canyon areas (west of Douglas). Description modified from Gable and

Agh Hornblende gneiss (Archean)—Fine-to medium-grained salt and pepper texture gneiss that is coarser grained than hornblende schist (As). Commonly interlayered with thin layers of hornblende schist (As) and quartzite (Aq). Description modified from Gable and

Aq Quartzite and garnet quartzite (Archean)—Quartzite is white massive quartzite and felsic matrix quartz- and granite-conglomerate; includes chert and clastic sandstone; crops out in the upper part of greenstone belt (description modified from Snyder, 1993). Garnet quartzite is dark-gray to black biotite-garnet-microcline-plagioclase-quartz rock. Garnet appears on foliated surfaces (description modified from Gable and others (1987).

As Hornblende schist and sillimanite-bearing quartz/mica schist (Archean)—Hornblende schist is dark, fine-grained dense, hornblende-bearing rock interlayered with light, felsic clinopyroxene rock; cleaves parallel along closely spaced planar surfaces; found in the Mormon Canyon area west of Douglas. Quartz/mica schist is medium-gray, thinly sillimanite-quartz-biotite-muscovite schist. Descriptions modified from Gable and

Hallberg, L.L., Case, J.C., Kirkaldie, A.L., and Jessen, C.A., 1999, Preliminary digital surficial map of the Douglas 30' x 60' Quadrangle, Converse, and Platte Counties, Wyoming: Wyoming State Geological Survey Geologic Hazards Section Digital Map (HSDM) 99-2, scale 1:100,000.

Hodson, W.G., Pearl, R.H., and Druse, S.A., 1973, Water resources of the Powder River basin and adjacent areas, northeastern Wyoming: U.S. Geological Survey Hydrologic Investigations Atlas HA-465,

Hunter, J., Ver Ploeg, A.J., and Boyd, C.S., 2005, Geologic map of the Casper 30' x 60' Quadrangle, Natrona and Converse Counties, Wyoming: Wyoming State Geological Survey Map Series (MS) 65,

Johnson, R.C., and Hills, F.A., 1976, Precambrian geochronology and geology of the Box Elder Canyon area, northern Laramie Range, Wyoming: Geological Society of America Bulletin, v. 87, no. 5, p.

Kohout, F.A., 1957, Geology and ground-water resources of the Kaycee irrigation project, Johnson County, Wyoming: U.S. Geological Survey Water Supply Paper 1360-E, p. 321-374, scale 1:31,680.

Love, J.D., Christiansen, A.C., and Sever, C.K., 1980, Geologic map of the Torrington 1° x 2° Quadrangle, southeastern Wyoming and western Nebraska: U.S. Geological Survey Miscellaneous Field Studies Map MF-1184, scale 1:250,000.

Love, J.D., Denson, N.M., and Botinelly, T., 1949, Geology of the Glendo area, Wyoming: U.S. Geological Survey Oil and Gas Investigations Map OM-92, scale 1:48,000.

Lowry, M.E., Rucker, S.J., and Wahl, K.L., 1973, Water resources of the Laramie, Shirley, Hanna basins, and adjacent areas, southeastern Wyoming: U.S. Geological Survey Hydrologic Investigations Atlas HA-471, scale 1:250,000.

McLaughlin, J.F., and Harris, R.E, 2004, Preliminary geologic map of the Torrington 30' x 60' Quadrangle: Wyoming State Geological Survey Open File Report (OFR) 04-11, scale 1:100,000.

Sando, W.J., and Sandberg, C.A., 1987, New interpretations of Paleozoic stratigraphy and history in the northern Laramie Range and vicinity, southeast Wyoming. U.S. Geological Survey Professional

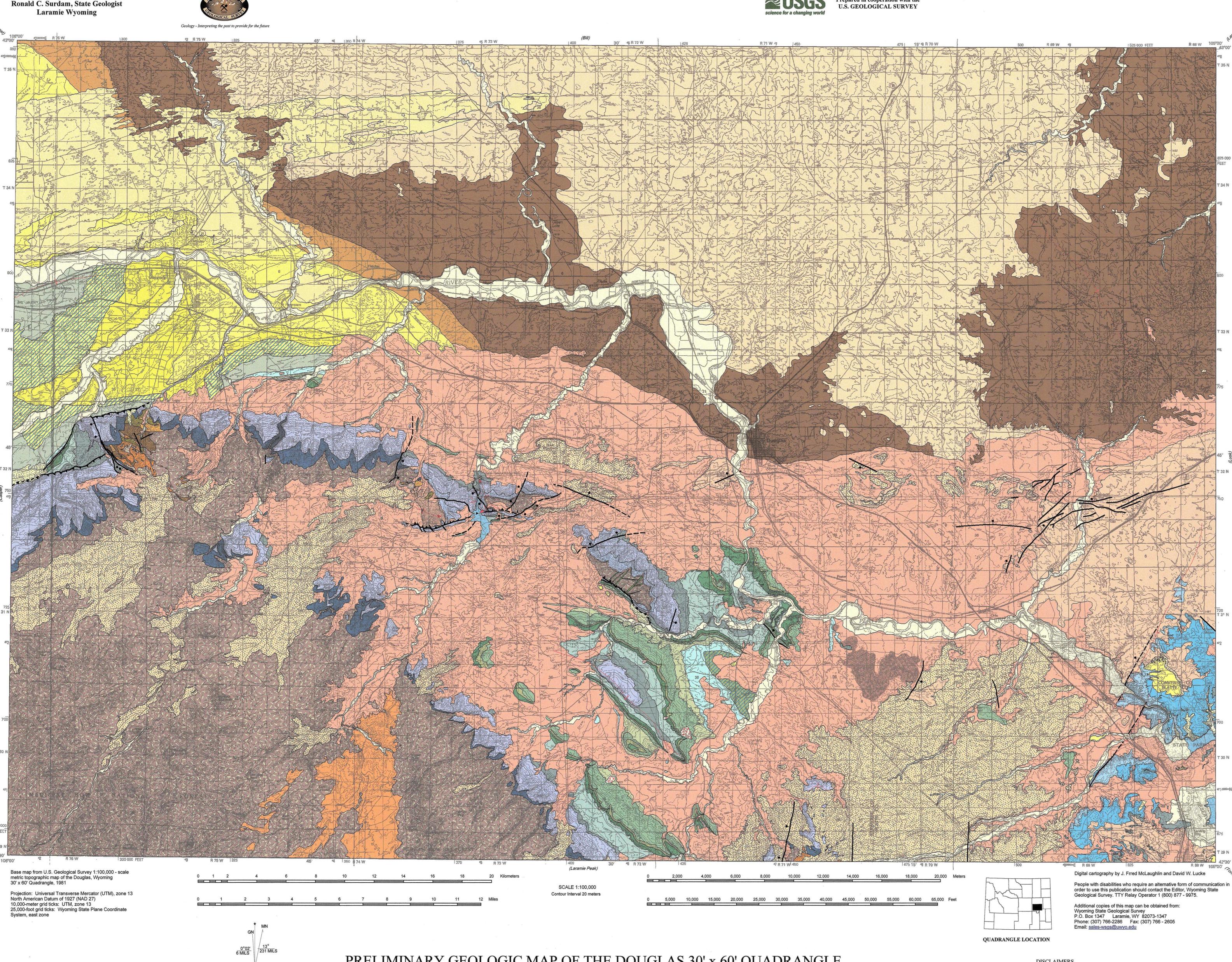
Sharp, W.N., and Gibbons, A.B., 1964, Geology and uranium deposits of the southern part of the Powder River Basin, Wyoming: U.S. Geological Survey Bulletin 1147-D, p. _____, scale 1:62,500.

Taucher, P., 1987, Unpublished geologic mapping of the Laprele Reservoir and Sheep Mountain area:

Snyder, G.L., and Bow, C.S., 1993, Geologic map of the Esterbrook-Braae area, Albany, Converse, and Platte Counties, Wyoming: U.S. Geological Survey Miscellaneous Investigations Series Map I-2232,

University of Wyoming student project. Ver Ploeg, A.J., 2004, Geologic map of the Poker Butte 1:24,000-scale Quadrangle, Johnson County, Wyoming: Wyoming State Geological Survey Open File Report (OFR) 04-13, scale 1:24,000, color.

Wittke, S.J., and Ver Ploeg, A.J., 2006, Preliminary geologic map of the Midwest 30' x 60' Quadrangle: Wyoming State Geological Survey Open File Report (OFR) 06-6, scale 1:100,000.



WYOMING STATE GEOLOGICAL SURVEY

PRELIMINARY GEOLOGIC MAP OF THE DOUGLAS 30' x 60' QUADRANGLE, CONVERSE, AND PLATTE COUNTIES, WYOMING

> J. Fred McLaughlin Alan J. Ver Ploeg

UTM GRID CONVERGENCE (GN)

1981 MAGNETIC DECLINATION (MN) AT CENTER OF SHEET

DIAGRAM IS APPROXIMATE

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