WYOMING STATE GEOLOGICAL SURVEY
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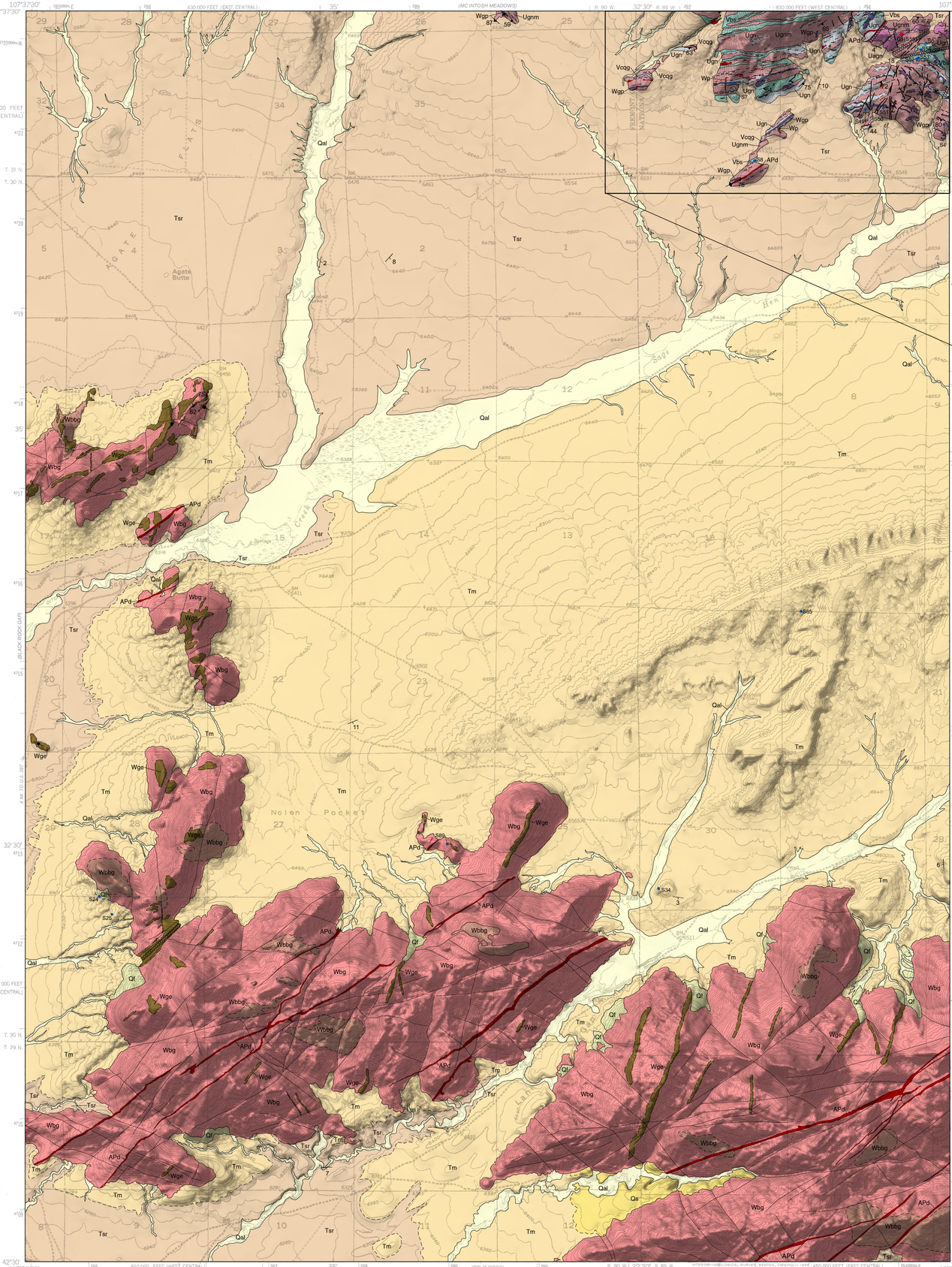
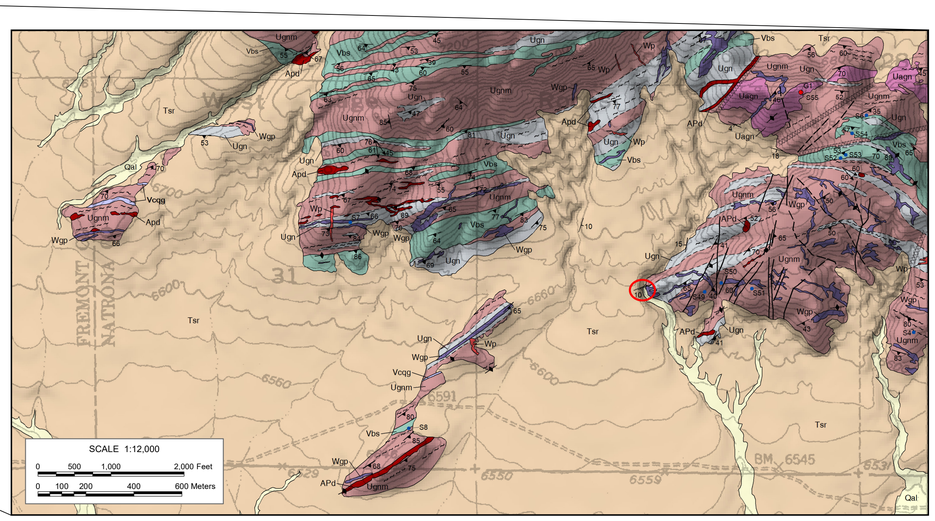
Interpreting the past, providing for the future

OPEN FILE REPORT 2019-4
Lankin Dome 1:24,000-scale
Bedrock Geologic Map





INSET MAP

EXPLANATION

CORRELATION OF MAP UNITS

Qal, Qs, Qf	Holocene	QUATERNARY		CENOZOIC
Unconformity				
Tm	Pliocene	NEOGENE	TERTIARY	
Unconformity				
Tsr	Miocene	NEOGENE	TERTIARY	
Unconformity				
APd	Paleoproterozoic	PROTEROZOIC		PRECAMBRIAN
Wp	Paleoproterozoic	PROTEROZOIC		PRECAMBRIAN
Wyoming Batholith: Wge, Wgp, Wbbg, Wbg	Neoarchean	ARCHEAN		PRECAMBRIAN
Basement Gneiss Complex: Vbs	Mesoarchean	ARCHEAN		PRECAMBRIAN
Basement Gneiss Complex: Vcqg, Uagn, Ugnm, Ugn	Paleoarchean	ARCHEAN		PRECAMBRIAN

MAP SYMBOLS

Definitions: *Certain—Estimated location <25 m (82 ft)*; *Approximate—Estimated location 25–100 m (82–328 ft)*; *Inferred—Estimated location >100 m (328 ft)*

- **Formation contact**—Continuous where certain, long dash where approximate, short dash where inferred
- **Fault**—Displacement unknown; continuous where certain, long dash where approximate, short dash where inferred, dotted where concealed
- **Fracture zone**—Zone of closely spaced faults
- **Shear zone—**Characterized by proto-mylonitic to mylonitic foliation; alteration is common
- **Joint—**Vertical or subvertical
- 15 **Strike and dip of inclined bedding**
- 50 **Strike and dip of foliation**
- **Strike of vertical foliation**
- 25 **Strike and dip of jointing**
- **Strike of vertical jointing**
- 60 **Strike and inclination of lineation—**Arrow points in direction of plunge
- S6 **Sample—**Showing sample name (refer to accompanying report for analyses)
- G1 **Geochronology sample—**Showing sample name (refer to accompanying report for analyses)

DESCRIPTION OF MAP UNITS

Cenozoic

Quaternary

Qal — **Alluvial deposits (Holocene)—**Unconsolidated to loosely consolidated clay, silt, sand, gravel, and cobbles within and along most drainages

Qs — **Eolian deposits (Holocene)—**Wind-blown silt and sand deposits that overlie Tertiary sediments, typically on west- and south-facing dip slopes; often occurs in stabilized dunes; deposits are up to 7 m (21 ft) thick

Qf — **Alluvial fan deposits (Holocene)—**Unconsolidated to loosely consolidated gravel, cobbles, boulders, and soil cover along slope faces. May include slope wash and alluvial and colluvial fans

Neogene

Tm — **Moonstone Formation (Pliocene and upper Miocene)—**Lower 152 m (500 ft) is dominated by tuffaceous to arkosic, fine- to medium-grained sandstone and coarse-grained arkosic conglomerate with numerous agate pebbles in the western part of the quadrangle; basal section in the eastern part of the quadrangle is characterized by several hundred feet of partly covered green-white quartz gravel and cobbles with granite boulders up to 1 m (3 ft) across and sporadic outcrops of green-white tuffaceous sandstone with abundant concretions. Upper section is characterized by fine- to medium-grained, massive to thinly cross-bedded, gray, buff, orange, white, and green tuffaceous to arkosic sandstone, gray to white pumicite, thick white shale, and thin beds of algal limestone; conspicuous bedded chalcedony, chert nodules, small Sweetwater moss agates up to 3 cm (1.2 in), undifferentiated mammal leg bone shards, and fossilized wood; zircon from interbedded tuffs yield U/Pb ages of 8.39 ± 0.24 and 11.30 ± 0.48 Ma, which support biostratigraphic constraints provided by late Miocene mammals (Scott, 2002); up to 413 m (1,356 ft) thick

Tsr — **Split Rock Formation (Miocene)—**Fine- to medium-grained, cross-bedded to massive, gray to buff tuffaceous sandstone, medium- to coarse-grained arkosic sandstone and conglomerate, cream to tan silty tuff, with minor blue-gray-white pumicite and olive drab claystone; conglomerate clasts are predominantly composed of locally derived Precambrian rocks and Rattlesnake Hills volcanics; sandstone beds contain conspicuous well-rounded, frosted, and hematite-coated quartz with abundant very fine grained hematite; minor chert nodules and small weathered Sweetwater moss agates up to 2.5 cm (1 in) (Love, 1961); thickness up to 305 m (1,000 ft)

Precambrian

APd — **Mafic dike (Paleoproterozoic and Neoarchean, undifferentiated)—**Diabase, amphibolite, and ultramafic dikes of multiple ages occur within the Lankin Dome quadrangle, many of which are oriented subparallel to the general foliation. Basaltic dikes are composed of plagioclase, olivine and pyroxene and have a preliminary age of ~1,500 Ma (Chamberlain and others, 2003). Paleoproterozoic dikes, ca. 2,115 Ma (U/Pb; Cola and Sutherland, 2014), are typically subvertical, relatively straight and uniform in thickness, and trend predominantly east-northeast; mafic dikes typically cross-cut the foliation of the Precambrian units and older structures; however, localized shearing also affects the dikes (2,649 ± 2.8 Ma, Grace and others, 2006)

Wp — **Pegmatite veins and dikes (Archean and younger)—**Pegmatite veins and dikes up to 15 m (50 ft) wide and up to 46 m (150 ft) in length cross-cut most Archean lithologies and structures and are largely undeformed; clear to opaque gray quartz-dominated dikes are most common, followed by quartz and feldspar ± muscovite and biotite; accessory minerals include but are not limited to tourmaline, corundum, fluorapatite, epidote, and nephrite jade

Wyoming Batholith (Neoarchean)

Wge — **Epidotized granite (Neoarchean)—**Epidotized biotite granite, banded biotite granite, leucogranite, and metamorphic phases occur as pale white to green and pink pods, sheets, and dikes within the unaltered host rock; these outcrops are typically more resistant than adjacent biotite granite, forming angular, blocky ridges and capping hilltops; potassium-bearing phases are sparse (McLaughlin and others, 2013); U/Pb analysis of zircon yielded an age of 2,520± 22 Ma and $^{207}Pb/^{206}Pb$ ages ranging from 2,624–2,521 Ma (Bagdonas and others, 2016; McLaughlin and others, 2013), which could be interpreted as the age of emplacement of the biotite granite at 2,620 Ma with a major alteration event at 2,520 Ma

Wgp — **Leucogranite dike (Neoarchean)—**Leucogranite occurs as sheets and dikes in the Wyoming Batholith and the older Archean gneisses, commonly intruding the granite and metamorphic fabrics at high angles, but also sub-parallel to the regional foliation in bodies ranging from <1–5 m (3–16 ft) in width; fine-grained leucogranite is typically recrystallized and granular, while medium- to coarse-grained outcrops appear less altered; contacts are either pegmatitic or grade into the surrounding biotite granite and banded biotite granite; primarily composed of quartz, perthitic microcline, and plagioclase with accessory biotite and magnetite (Bagdonas and others, 2016; McLaughlin and others, 2013); typically more resistant than the surrounding lithologies and therefore tend to form ridges and cap hilltops

Wbbg — **Leucocratic banded biotite granite (Neoarchean)—**Medium- to coarse-grained leucocratic banded granite occurs most commonly along the northern and upper margins of the Wyoming Batholith and is characterized by millimeter- to decimeter-scale compositional banding; banded biotite granite is composed of 35–40 percent quartz, 20–35 percent microcline, 20–30 percent plagioclase, <5 percent biotite, and <5 percent magnetite with accessory epidote, titanite, zircon, and apatite (Bagdonas and others, 2016); compositional banding and magmatic foliation is typically defined by aligned biotite; the biotite content is more variable than in the massive biotite granite and is typically less abundant or absent where magnetite is abundant (Bagdonas and others, 2016); contact between the leucocratic banded biotite granite and the biotite granite is variably sharp to gradational with local folding; U/Pb analysis of zircon yielded an emplacement age of 2,620 ± 5 Ma (Bagdonas and others, 2016; McLaughlin and others, 2013)

Wbg — **Biotite granite (Neoarchean)—**The majority of the Granite Mountains batholith exposures on the Lankin Dome quadrangle are composed of relatively homogenous, medium- to coarse-grained biotite granite that lacks enclaves and mafic intrusions; composed of 30–40 percent microcline, 25–35 percent quartz, 25–35 percent plagioclase, and 1–7 percent biotite with accessory magnetite, epidote, apatite, zircon, and titanite (Bagdonas and others, 2016; McLaughlin and others, 2013); locally, megacrystic K-feldspar up to 2 cm (<1 in) in length and extensive biotite mats are common; magmatic foliation is defined by aligned biotite and feldspar; Bagdonas (2014) dated zircon in this granite at 2,623 ± 4.3 Ma by U/Pb analysis

Barlow Gap Group

Vbs — **Barlow Springs Formation (Mesoarchean and Paleoarchean)—**Primarily consists of interlayered quartzite, pelitic to psammitic schist, banded iron formation, amphibolite gneiss, felsic gneiss, and metagabbro intrusions; amphibolite gneisses include metabasalt, tremolite-chlorite schist, and anthophyllite gneiss (Bickford, 1977); basal unit is fuchsitic green to rusty red-brown or gray quartzite that is variable layered to massive and vitreous to coarsely crystalline that grades into greenish-gray psammitic schist (Bickford, 1977); detrital zircon from quartzite within the Barlow Springs Formation yielded a primary population at ~ 3,300 Ma (Langstaff, 1995); magmatic zircon from a metadacite dikes yielded emplacement ages of 2,856 ± 55 Ma (Langstaff, 1995), and 2,864 ± 7.8 Ma (Fruchey, 2002)

Basement gneiss complex

Vcqg — **Cordierite-quartz gneiss (Mesoarchean)—**Cordierite-quartz gneisses **(CQG)** are massive to foliated, steel-blue, medium- to fine-grained, micaceous, and commonly associated with a thinly layered, black to brown biotite-gedrite schist; the gneiss is primarily composed of 60–80 percent blue-gray rutilated quartz, cordierite (commonly altered to pinite), biotite, and chlorite, with accessory titanite, zircon, and variably sericitized plagioclase (McLaughlin, 2016); the schist is composed of biotite, quartz, talc, chlorite, zircon, and allanite (McLaughlin and others, 2013) ± coarse asymmetric garnet porphyroclasts up to 2 cm (0.8 in); metasediment-derived CQG lie nonconformably over the over the Paleoarchean massive orthogneiss, which is likely the original depositional relationship (McLaughlin and others, 2013) but is also found as tectonic inclusions or thrust sheets, and in areas of high shear strain, where it grades laterally into micaceous hornblende-bearing massive orthogneiss (McLaughlin, 2016); previously mapped as Frank metaquartzite on Stampede Meadow geologic map (McLaughlin and others, 2013)

Uagn — **Amphibolite gneiss (Paleoarchean)—**Medium- to coarse-grained amphibolite gneiss occurs in large bodies juxtaposed against the massive gneiss (Vcqg); foliation typically parallels that of the surrounding orthogneiss and is defined by aligned amphibole and stretched feldspar; grain size and strength of the foliation are highly variable. The original contact relationship between the amphibolite and surrounding gneisses is unknown due to significant shearing, folding, and imbricate faulting. U/Pb analyses of zircon (sample G1) yielded a metamorphic age of 2,658.5 ± 3.3 Ma

Ugnm — **Massive gneiss (Paleoarchean)—**A suite of variably deformed potassic gneisses that are coarse- to fine-grained, equigranular to porphyritic, lineated to foliated; foliation defined by parallelism of biotite, lineation defined by stretched feldspar and axial planar cleavage; typically composed of plagioclase, potassium feldspar, quartz, biotite with allanite, titanite, zircon and apatite (Frost and others, 2016); the Sacawee orthogneiss is most abundant member of the massive gneiss, which is a calc-alkalic, medium- to coarse-grained, porphyritic, pink-orange, granitic gneiss; Frachey (2002) constrained the age of the Sacawee to be 3,258 ± 8 Ma by U/Pb analysis, while U/Pb ages for the massive gneiss generally fall between 3,300–3,330 Ma (Frost and others, 2016)

Ugn — **Undifferentiated gneiss (Paleoarchean)—**Members of the massive and layered gneisses as well as supracrustal suites have been juxtaposed by tight folding, shearing, faulting, and intrusive relationships and the scale of the structural complexity is often too small to be resolved at the 1:24,000 scale; undifferentiated gneiss may also refer to outcrops where layered gneiss is suspected, but further analytical work is necessary to confirm this. The layered gneiss is a suite of calcic, fine- to medium-grained, equigranular, tonalitic rocks with layering defined by differences in grain size, degree of deformation, and compositional variation; typically composed of plagioclase, quartz, and biotite with accessory allanite, titanite, zircon, and apatite (Frost and others, 2016); U/Pb analyses of multiple members of the layered gneiss yield ages generally between 3,385–3,450 Ma (Frost and others, 2016; McLaughlin, 2016), while one sample (from the Antler orthogneiss of Langstaff, 1995) yielded a magmatic age of 3,370 ± 12 Ma. Cola and Sutherland (2014) dated a fine-grained gneiss and a bluish-black quartzite by U/Pb analyses at 3,325 Ma and 3.3 Ga respectively and assign them to the Antler orthogneiss

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Base map from U.S. Geological Survey 1:24,000-scale topographic map of the Lankin Dome, Wyoming Quadrangle, 1951, photorevised 1984

Base hillshade derived from a U.S. Geological Survey tile of the National Elevation Dataset (NED); 10-meter Digital Elevation Model (DEM), 2013; azimuth 315°, sun angle 45°, vertical exaggeration 2.7

Projection: Universal Transverse Mercator (UTM), zone 13
North American Datum of 1927 (NAD 27)
1,000-meter grid ticks: UTM, zone 13
10,000-foot grid ticks: Wyoming State Plane Coordinate System, west central and east central zones

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MN
GN
1°44'
9°44'
UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24,000
1 0.5 0 1 Mile
1,000 0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 Feet
1 0.5 0 1 Kilometer
CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

WYOMING QUADRANGLE LOCATION

Digital cartography by Patricia M. Webber
Map edited by Suzanne C. Luhr

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PRELIMINARY GEOLOGIC MAP OF THE LANKIN DOME QUADRANGLE, FREMONT AND NATRONA COUNTIES, WYOMING

by
Patricia M. Webber and Robert W. Gregory

2019

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