WYOMING STATE GEOLOGICAL SURVEY
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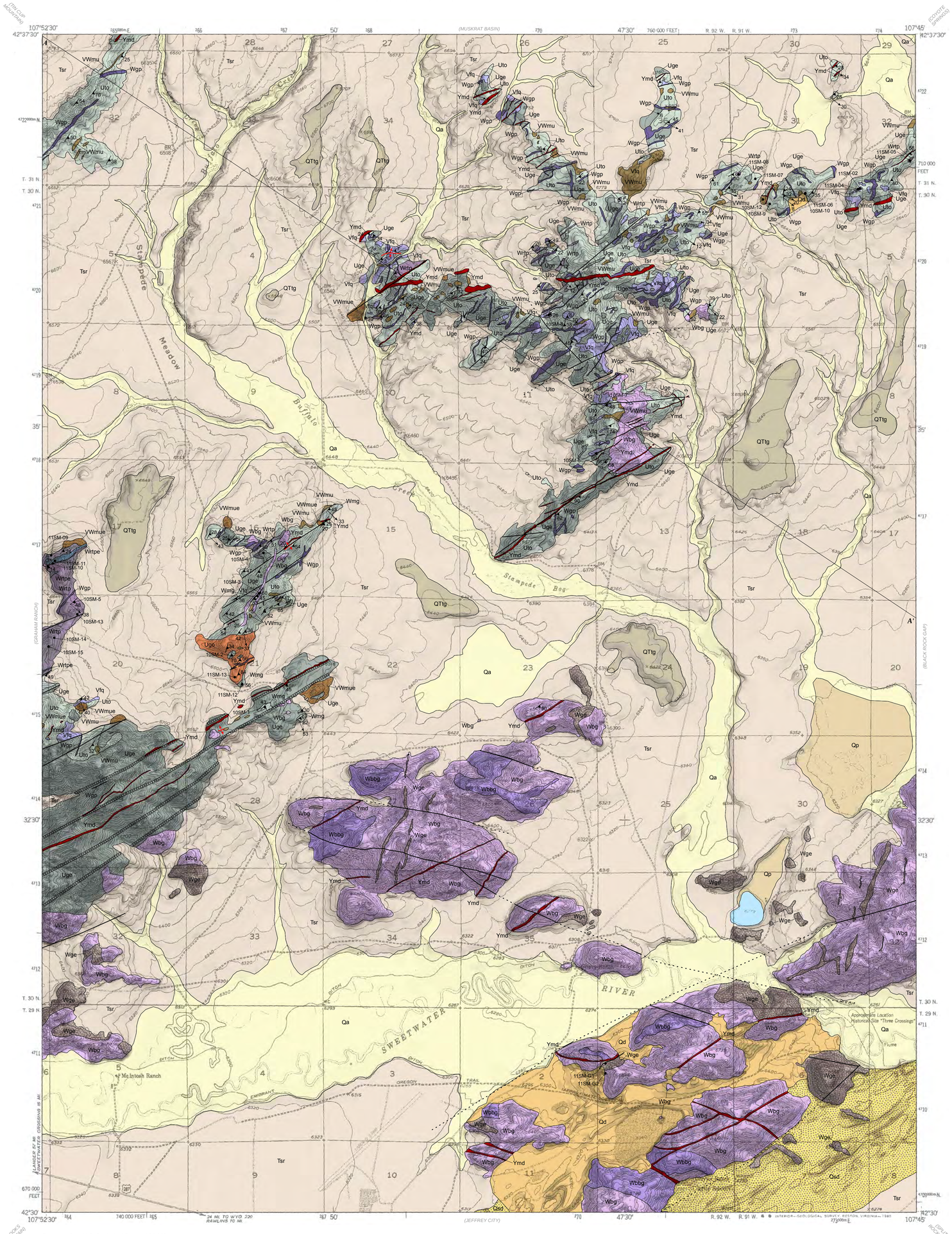
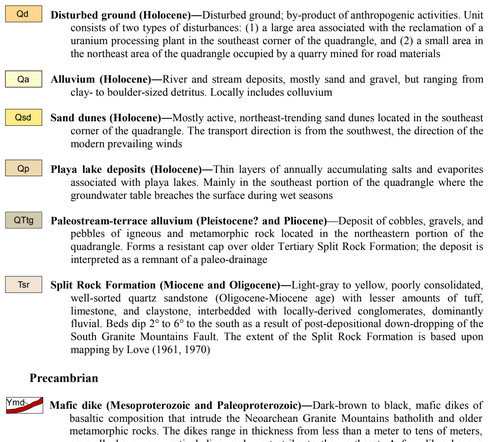
Geology - Interpreting the past - providing for the future

MAP SERIES 102
Stampede Meadow 1:24,000 - scale Bedrock Geologic Map



EXPLANATION

CORRELATION OF MAP UNITS



MAP SYMBOLS

- **Lithologic contact**
- **Fault**—Displacement unknown; dashed where approximate, dotted where concealed
- **Fracture zone**—Zones of closely spaced faults
- **Antiform**
- **Line of cross section**
- **Strike and dip of foliation**
- **Bearing and plunge of lineation**
- **Sample location and identification number**
- **Water body**

DESCRIPTION OF MAP UNITS

Cenozoic

Qd **Disturbed ground (Holocene)—**Disturbed ground; by-product of anthropogenic activities. Unit consists of two types of disturbances: (1) a large area associated with the reclamation of a uranium processing plant in the southeast corner of the quadrangle, and (2) a small area in the northeast area of the quadrangle occupied by a quarry mined for road materials

Qa **Alluvium (Holocene)—**River and stream deposits, mostly sand and gravel, but ranging from clay- to boulder-sized detritus. Locally includes colluvium

Qsd **Sand dunes (Holocene)—**Mostly active, northeast-trending sand dunes located in the southeast corner of the quadrangle. The transport direction is from the southwest, the direction of the modern prevailing winds

Qp **Playa lake deposits (Holocene)—**Thin layers of annually accumulating salts and evaporites associated with playa lakes. Mainly in the southeast portion of the quadrangle where the groundwater table breaches the surface during wet seasons

QTtg **Paleostream-terrace alluvium (Pleistocene? and Pliocene)**—Deposit of cobbles, gravels, and pebbles of igneous and metamorphic rock located in the northeastern portion of the quadrangle. Forms a resistant cap over older Tertiary Split Rock Formation; the deposit is interpreted as a remnant of a paleo-drainage

Tsr **Split Rock Formation (Miocene and Oligocene)—**Light-gray to yellow, poorly consolidated, well-sorted quartz sandstone (Oligocene-Miocene age) with lesser amounts of tuff, limestone, and claystone, interbedded with locally-derived conglomerates, dominantly fluvial. Beds dip 2° to 6° to the south as a result of post-depositional down-dropping of the South Granite Mountains Fault. The extent of the Split Rock Formation is based upon mapping by Love (1961, 1970)

Precambrian

Ymd **Mafic dike (Mesoproterozoic and Paleoproterozoic)—**Dark-brown to black, mafic dikes of basaltic composition that intrude the Neoarchean Granite Mountains batholith and older metamorphic rocks. The dikes range in thickness from less than a meter to tens of meters, generally have near-vertical dips, and most strike to the northeast. A few dikes have a different orientation, but are likely the same age as the northeast striking variety. Most dikes are unaltered and are composed of plagioclase with subequal amounts of olivine and pyroxene. A preliminary age of ~1.5 Ga was reported for a mafic dike in the Granite Mountains by Chamberlain and others, (2003)

Neoarchean Granite Mountains batholith

Granitic rocks of the Neoarchean Granite Mountains batholith account for the majority of Precambrian outcrops in the Granite Mountains, including the outcrops in the southern portion of Stampede Meadow quadrangle. The Granite Mountains batholith is composed of equigranular and porphyritic biotite granite, leucogranite sheets and dikes, and banded biotite granite that is commonly located along the margins of the batholith. Locally, the granites of the Granite Mountains batholith are extensively epidotized

Wge **Epidotized granite (Neoarchean)—**Epidotized granites crop out as sheets, dikes, and pods within unaltered granites. Epidotized granites contain few to no potassium-bearing phases. Epidotization has altered both biotite granite and banded biotite granite as well as the older metamorphic rocks along the margins of the Granite Mountains batholith, indicating that epidotization is later than the intrusion of the batholith.

U-Pb analysis of 22 zircon grains by sensitive high-resolution ion microprobe (SHRIMP) from an epidotized sample of biotite granite (11SM-G2) yielded an imprecise concordia age of 2520 ± 22 (MSWD = 33; unpublished data of the authors). $^{207}Pb/^{206}Pb$ ages of concordant zircon range from 2624 to 2521 Ma. There are multiple interpretations of these data: the biotite granite may be 2.62 Ga but affected by a major alteration event at 2.52, or it may have been intruded at 2.52

Wgp **Leucogranite dike (Neoarchean)—**Leucogranite dikes intrude the Granite Mountains batholith and older metamorphic rocks, and commonly cross-cut the granite and metamorphic fabrics at high angles. Some of the dikes are subhorizontal. Dikes vary from < 1 m to up to 5 m in width. Some dikes are medium-grained, others are pegmatitic, and still others have medium-grained cores and pegmatitic margins. The dikes are composed of quartz, perthitic microcline, and plagioclase, with minor amounts of biotite and magnetite

Wbg **Biotite granite (Neoarchean)—**Medium- to coarse-grained and generally homogenous granite composes the majority of the outcrops of the Granite Mountains batholith in the Stampede Meadow quadrangle. It is a compositionally uniform granitic body lacking enclaves and mafic inclusions, although it contains sparse, fine-grained, biotite-rich lenses. In some locations, biotite granite grades into porphyritic biotite granite containing K-feldspar megacrysts up to 2 cm in length.

The biotite granite is composed of microcline (30-40 percent), quartz (25-35 percent), plagioclase (25-35 percent), and biotite (2-5 percent) with minor magnetite, epidote, and sphene. Locally, rutile needles are present in quartz. Biotite is variably altered to chlorite and epidote. Plagioclase is somewhat sericitized. Epidote occurs as discrete subhedral grains associated with biotite. A few grains of monazite are present

Wbbg **Banded biotite granite (Neoarchean)—**Medium- to coarse-grained biotite granite characterized by discontinuous streaks and folded wisps of biotite and fine- to medium-grained, leucocratic, magnetite-bearing bands. Magnetite-rich layers contain sparsely distributed subhedral grains of magnetite up to 2 cm in size. The banded biotite granite is found mainly at the margins of the batholith and grades into biotite granite.

The banded biotite granite is composed of quartz (35-40 percent), microcline (20-35 percent), plagioclase (20-30 percent), biotite (1-3 percent), magnetite (1-2 percent) and minor amounts of epidote, apatite, sphene, sericite, and zircon. Locally, rutile needles are present in quartz.

Zircon grains from an epidotized sample of banded biotite granite (11SM-G1) include a prominent group that defines an age of 2620 ± 5 Ma (unpublished data of the authors). Other zircon grains have $^{207}Pb/^{206}Pb$ ages from 2.55 to 2.35 Ga, suggesting open system behavior of the U-Pb system in the Neoarchean

Wrtp **Radio Tower Hill paragneiss (Neoarchean)—**Quartz-plagioclase-biotite-hornblende gneiss with minor sphene, zircon, allanite, and apatite extends from the west-central margin northeast to the north-central part of the quadrangle. Garnet-bearing paragneiss is found in the north-central and eastern portions of the quadrangle. The paragneiss is typically strongly foliated; in westernmost exposures leucosome distributed throughout the host paragneiss indicates the rock was partially melted. In some places the paragneiss is slightly altered, exhibiting epidote rimming allanite, although plagioclase is fresh. In other areas the rock is epidotized, plagioclase is altered to sericite and zoisite, and both epidote and chlorite are present. The largest continuous exposure in the west-central portion of the quadrangle hosts various thin bands of inclusions trending parallel to foliation, including boudinaged amphibolite and mafic rocks, and thin layers of gray, foliated orthogneiss. Deformation of the inclusions within the Radio Tower Hill paragneiss suggests they were incorporated during the deformational event that defines the regional foliation. Paragneiss is locally found as inclusions in older gneisses in the eastern portions of the quadrangle.

A leucosome from the Radio Tower Hill paragneiss (10SM13) yielded 11 zircons defining an age of 2636 ± 2 Ma, which is interpreted as the time of partial melting (unpublished data of the authors). A sample of the paragneiss without leucosomes (10SM5) yielded sparse concordant zircon with ages of around 3.2 Ga, 2.9 Ga, and 2.68 Ga. Three concordant analyses of sphene from this sample gave ages of 2628, 2655, and 2695 Ma (unpublished data of the authors). Based upon this limited age information, it appears that the paragneiss is younger than the Frank quartzite (Vfq) and could be coeval with the metagraywackes of McDougall Gulch in the Rattlesnake Hills. The paragneiss was probably metamorphosed one or more times, including at 2.63 Ga (Frost and others, 2006)

Wrtpe **Epidotized Radio Tower Hill paragneiss (Neoarchean)—**White to green epidotized Radio Tower Hill paragneiss. Epidotized paragneiss is present in the southwest portion of the quadrangle. It forms tabular and blocky outcrops on which the communication tower is built

Wmg **Monzogranite orthogneiss (Neoarchean)—**Light-gray monzogranite orthogneiss occurs as resistant ridges striking to the northeast in the west-central portion of the quadrangle. Potassium feldspar megacrysts record a dominantly dextral sense-of-shear. The monzogranite orthogneiss is composed of approximately 45 percent microcline, 25 percent plagioclase, 30 percent quartz, and 5 percent biotite with minor sphene and zircon

Detrital zircon from Frank subarkosic quartzite sample 10SM7 was analyzed for U-Pb isotopes by ICP-MS (unpublished data of the authors). 119 analyses of zircon ranged from concordant to strongly discordant. The grains define 2 chords on concordia. A younger group (n = 44) yields an age of 2928 ± 30 Ma (MSWD = 23), and an older group (n = 75) yields 3217 ± 17 (MSWD = 14)

VWmu **Amphibolitic, gabbroic, and ultramafic rocks, undifferentiated (Neoarchean and Mesoarchean)—**Dark-brown to black mafic and ultramafic rocks found as inclusions and intrusions in the gneisses. The coarse-grained quartz-bearing gabbro is mostly found in relatively small, grouped, unfoliated pods, although a large outcrop exists in the north-central portion of the quadrangle. Hornblende in the metagabbro is altered to chlorite, tremolite, and epidote, and plagioclase is altered to sericite. Fine-grained metabasalt is comprised primarily of altered hornblende and plagioclase. Most outcrops of this unit are inclusions, although some may be emplaced by tectonic processes. Inclusions are found in the Radio Tower Hill paragneiss (Wrtp) and in the oldest tonalitic orthogneiss, limiting the age of this unit to between 3.3 and 2.63 Ga

VWmue **Epidotized amphibolitic, gabbroic, and ultramafic rocks, undifferentiated (Neoarchean and Mesoarchean)—**White to green pervasively epidotized quartz metagabbro and metabasalt. This unit contains abundant pits where prospectors searched for nephritic jade

Vfq **Frank feldspathic metaquartzite (Mesoarchean)—**Massive to foliated steel-blue-colored, medium-grained micaceous feldspathic metaquartzite composed of between 60 and 85 percent quartz, with plagioclase (commonly altered to sericite), biotite (commonly altered to chlorite), local cordierite, and minor zircon and sphene. The quartz contains abundant needles of rutile, which provides its steel-blue color and evidence that the provenance of the original detrital grains was from an area where the quartz had undergone high temperature crystallization and subsequent exsolution of rutile. Some samples exhibit checkerboard subgrains in quartz, which is evidence of high-temperature strain (Kruhl, 1996).

Frank metaquartzite is present in the northeastern and west-central parts of the quadrangle and appears thickest in sections 11 and 12, T30N R 92W. The Frank metaquartzite in the Stampede Meadow quadrangle is one of a number of quartzites, quartz arenites and arenites that predate the Late Archean Granite Mountains batholith and are found throughout the northern Granite Mountains and at South Pass. At Barlow Gap, similar quartzite is part of the ~2.85 Ga Barlow Springs Group of supracrustal rocks (Fruchey, 2002).

In the eastern portion of the map area, the Frank metaquartzite overlies a thin, dark-brown to black biotite-rich pelitic schist. The schist sits nonconformably upon tonalitic gneiss (Uto) and contains biotite, quartz, talc, chlorite, abundant zircon, and minor allanite. High magnesium content and talc suggests an ultramafic source (samples 11SM3 and11SM4). In a small area near the center of the quadrangle, the Frank subarkosic quartzite is associated with a thin band of massive iron formation. Both the pelitic schist and iron formation are too small to map at a 1:24,000 scale.

Outcrops of the Frank metaquartzite lie nonconformably upon Paleoarchean orthogneiss, likely maintaining the initial depositional relationship. However, the quartzite is also found as tectonic inclusions, or thrust sheets within the orthogneiss in areas that have undergone high shear strain

Uto **Tonalitic orthogneiss (Paleoarchean)—**This unit includes texturally variable tonalitic orthogneiss that is undeformed, lineated, foliated, and/or migmatic orthogneiss with no structural features. It also includes some minor epidotized variants of all the aforementioned rock types. Coarse- to fine-grained tonalitic to granitic orthogneiss is the dominant unit in the northern half of the quadrangle. These orthogneisses contain biotite ± hornblende. Potassium feldspar is a minor phase, and is present as interstitial grains or has exsolved from plagioclase. Zircon is an accessory phase.

Lineated tonalitic orthogneiss is commonly coarse-grained, with large biotite, feldspar, and quartz grains. Biotite is commonly aggregated, giving the gneiss a spotted appearance. L>S tectonites are the dominant deformational fabric of these gneisses in the Stampede Meadow quadrangle. Outcrops tend to weather more readily than foliated orthogneiss due to the massive, coarse-grained texture of the orthogneiss. Foliated tonalitic orthogneiss is fine-grained and defined by platy, evenly distributed biotite that makes this unit appear darker in color than other orthogneiss. It can be easily confused with older tonalitic inclusions, or thin bands of paragneiss.

In small, localized areas this unit includes distinct plagioclase-quartz-hornblende gneiss that mostly lacks penetrative deformation (11SM-7). Some of the hornblende is poikilitic with quartz inclusions, indicating that it formed by hydration of augite. Some augite remnants are rimmed by hornblende. Quartz grains in these rocks contain rutile needles, indicating crystallization at high temperature and pressure. The rutilated quartz also indicates that this orthogneiss could be the source for the quartz grains in the Frank feldspathic metaquartzite (Vfq), though outcrops of the unit are sparse

Ugo **Granitic orthogneiss (Paleoarchean)—**Pale- to medium-gray, fine- to medium-grained granitic orthogneiss. Unlike the tonalitic orthogneiss, the granitic orthogneiss commonly does not exhibit a penetrative structural fabric, but in places it has a nebulitic appearance. This variant of orthogneiss tends to be lighter in color than tonalitic orthogneiss, either because biotite is less abundant or because biotite forms schlieren. It is slightly more resistant to weathering than other gneisses and is found predominantly in the southern half of the Stampede Meadow quadrangle. The granitic orthogneiss generally contains more inclusions (such as metagabbro, amphibolite, and foliated tonalitic orthogneiss) than tonalitic orthogneiss

Uge **Epidotized gneiss (Paleoarchean)—**White to pale-green, fine- to medium-grained orthogneiss with pink and green altered zones reflecting hydrothermal alteration and epidotization. Relict structures such as foliations and lineations are still evident. Epidotized orthogneiss is highly resistant to weathering and often caps ridges and peaks in the Stampede Meadow quadrangle

MAP REFERENCES

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

Base hillshade derived from USDA/NRCS–National Cartography & Geospatial Center 10-meter Digital Elevation Model (DEM), 2000; azimuth 315°, sun angle 45°, vertical exaggeration 1.6

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 zone

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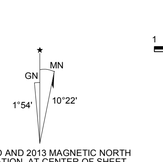


UTM GRID AND 2013 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

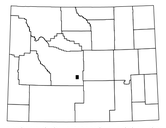
SCALE 1:24,000

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 J. Fred McLaughlin, Robin W. Lyons, and Phyllis A. Ranz

Map edited by Arthur W. Snoke and Suzanne C. Luhr

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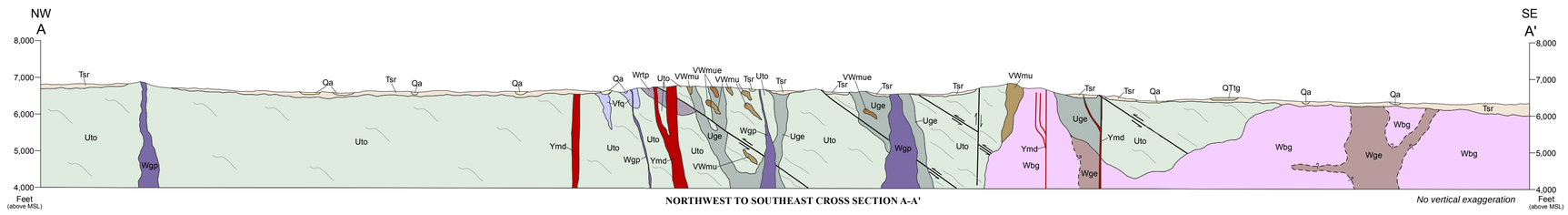

NORTHWEST TO SOUTHEAST CROSS SECTION A-A'

No vertical exaggeration

GEOLOGIC MAP OF THE STAMPEDE MEADOW QUADRANGLE, FREMONT COUNTY, WYOMING

by

J. Fred McLaughlin, Davin A. Bagdonas, Carol D. Frost, and B. Ronald Frost

2013

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