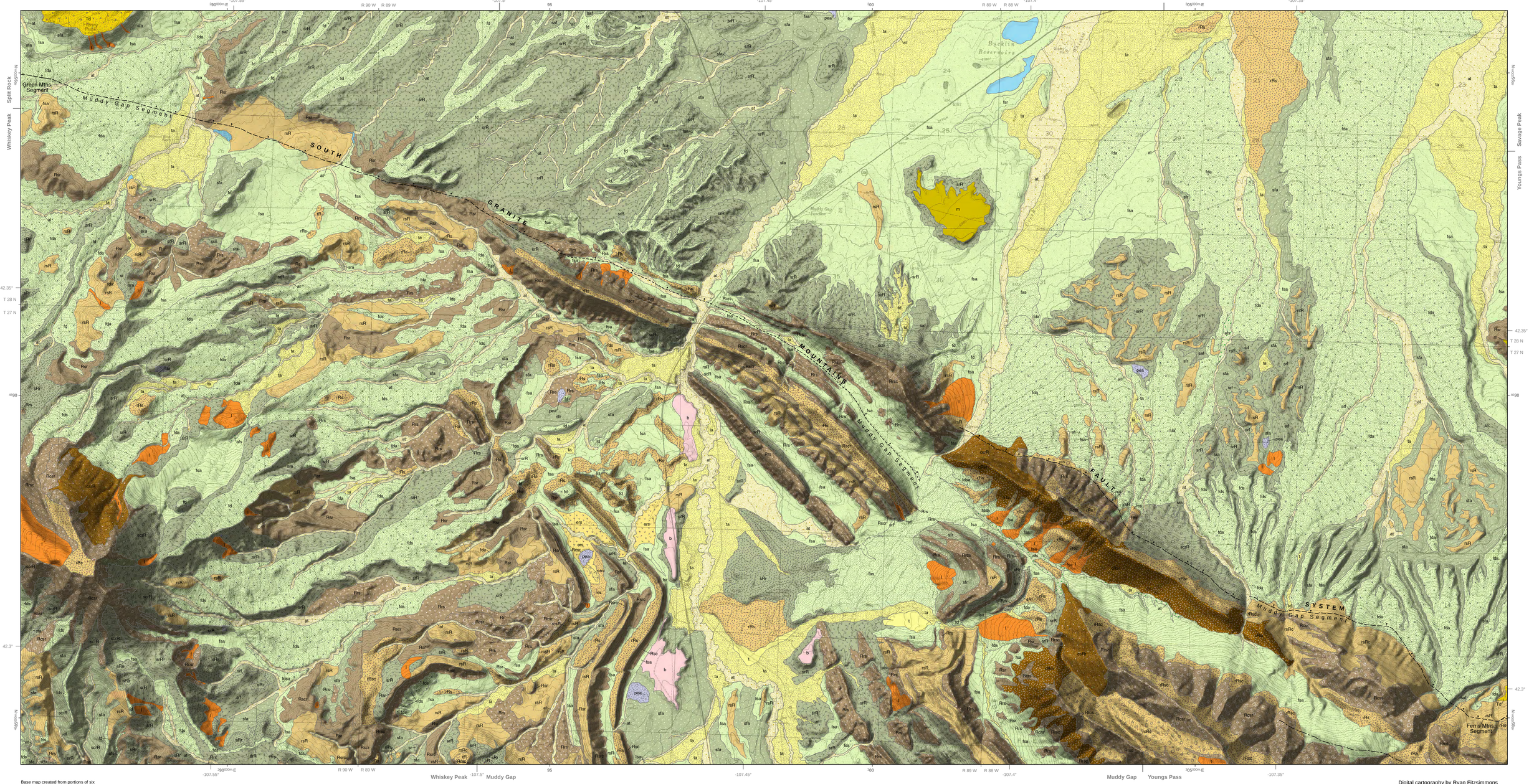
WYOMING STATE GEOLOGICAL SURVEY
Thomas A. Drean, Director and State Geologist
Laramie, Wyoming

Interpreting the past, providing for the future

OPEN FILE REPORT 2017-4
Muddy Gap Area 1:24,000-scale
Surficial Geologic Map



Base map created from portions of six U.S. Geological Survey 1:24,000-scale topographic quadrangle maps: Split Rock, 1951, Photorevised 1984; Bucklin Reservoirs, 1951, photorevised 1981; Savage Peak, 1951, photorevised 1981; Whiskey Peak, 1962, photorevised 1984; Muddy Gap, 1962, photorevised 1981; and Youngs Pass, 1962, photorevised 1981

Base hillshade derived from United States Elevation Data (NED), 10-meter Digital Elevation Model (DEM), 2009; 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

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MN
GN
9°46'
UTM 2017 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

0 0.5 1 2 Miles
0 0.5 1 2 3 Kilometers

SCALE 1:24,000
CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

0 500 1,000 1,500 2,000 2,500 3,000 Meters
0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 8,000 9,000 10,000 Feet

Digital cartography by Ryan Fitzsimmons
Map edited by Suzanne C. Luhr

Prepared in cooperation with and research supported by the U.S. Geological Survey, National Cooperative Geologic Mapping Program, under USGS award number G16AC00199. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

PRELIMINARY SURFICIAL GEOLOGIC MAP OF THE MUDDY GAP AREA, CARBON AND FREMONT COUNTIES, WYOMING

by
Seth J. Wittke and Ryan P. Fitzsimmons
2017

EXPLANATION

DESCRIPTION AND CLASSIFICATION OF MAP UNITS

Alluvium—Unconsolidated detrital material deposited during recent geologic time by a stream or other body of running water, as a sorted or semi-sorted sediment in the bed of a stream or river, as a cone or fan at the base of a mountain slope; stream and river deposits. Does not include subaqueous deposits in seas, estuaries, lakes, or ponds

- Alluvium and alluvial fan deposits with minor components of slopewash (afs)
- Alluvium and terrace deposits (at)

Terrace deposits—Relict alluvial deposits on relatively flat, horizontal, or gently inclined surfaces that are bounded by a steeper ascending slope on one side and a steeper descending slope on the opposite side

- Terrace deposits (t)
- Terrace and alluvial deposits (ta)
- Dissected terrace deposits (td)

Structural terrace—An elevated shallowly dipping or horizontal, planar surface capped by resistant alluvium surrounded on all sides by steeply dipping slopes

- Dissected structural terrace deposits (Td)

Alluvial fan deposits—A fan-shaped deposit made by a stream or debris flow, where they have run out onto a level (or nearly level) plain

- Alluvial fan and alluvium deposits with minor components of slopewash (fas)
- Dissected alluvial fan deposits (fd) with minor components of alluvium (fda), slopewash (fds), or slopewash and alluvium (fdsa)
- Alluvial fan and slopewash deposits with minor components of alluvium (fsa) or residuum (fsr)

Bench deposits—A long, narrow, comparatively level area bounded by steeper slopes above and below

- Bench deposits (b)

Mesa—An isolated, nearly level landmass standing distinctly above the surrounding country, bounded by abrupt or steeply sloping erosion scarps on all sides and capped by layers of resistant, nearly horizontal rock; a bedrock-capped plateau or tableland

- Mesa deposits (m)

Playa lake deposits—Materials deposited from broad, shallow sheets of water which quickly gather and evaporate, leaving mud flats, evaporite deposits, or both (depending on chemical composition of the waters and degree of evaporation)

- Playa lake and eolian deposits with minor components of alluvium (pea)

Eolian deposits—Materials, including sand, silt, and clay that have been transported and deposited by wind

- Eolian and alluvium deposits with minor components of slopewash (eas)
- Eolian and residuum deposits with minor components of slopewash (ers)

Landslide deposits—Soil and rock material that has moved downslope, usually en masse, under gravitational influence; earth and rock that become loosened from a hillside and slides, flows, or falls down the slope

- Landslide deposits (l)

Slopewash and colluvium—Slopewash is soil and rock material that has moved down a slope by gravity assisted by running water. Colluvium is a loose, heterogeneous, and incoherent mass of soil material and/or rock fragments deposited by rainwash, sheetwash, or slow continuous downslope creep, usually at the foot of a cliff or on the surface of a slope, and deposited there chiefly by gravity

- Colluvium and bedrock with minor components of residuum and slopewash (cRrs) or slopewash and residuum (cRsr)
- Colluvium and slopewash with minor components of bedrock and residuum (csRr) or residuum and bedrock (csrR)
- Slopewash and alluvial deposits with minor components of alluvial fans (saf)
- Slopewash and colluvial deposits with minor components of alluvial fans and residuum (scfr), bedrock (scR), or residuum and bedrock (scrR)
- Slopewash and alluvial fan deposits with minor components of alluvium (sfa) or residuum (sfr)
- Slopewash and bedrock deposits with minor components of alluvium (sRa) or residuum (sRr)
- Slopewash and residuum deposits (sr) with minor components of alluvium (sra), colluvium (src), alluvial fans (srf), or bedrock (srR)

Residuum—A residual deposit remaining in place after the decomposition of bedrock. Residuum is an accumulation of rock debris formed by weathering and remaining essentially in place after all but the least soluble constituents have been removed, usually forming a comparatively thin surface layer concealing the unweathered or partially altered bedrock below

- Residuum and colluvium deposits with minor components of bedrock and slopewash (rcRs), slopewash (rcs), or slopewash and bedrock (rcsR)
- Residuum and eolian deposits with minor components of slopewash (res)
- Residuum and bedrock deposits (rR) with minor components of slopewash (rRs) or slopewash and colluvium (rRsc)
- Residuum and slopewash deposits with minor components of bedrock (rsR) or bedrock and colluvium (rsRe)

Bedrock outcrops—Bedrock outcrops are areas where the underlying bedrock is exposed and unaltered (usually lithified) at the surface

- Bedrock and colluvium deposits with minor components of residuum and slopewash (Rcrs) or slopewash and residuum (Rcsr)
- Bedrock and residuum deposits (Rr) with minor components of colluvium and slopewash (Rrcs), eolian deposits (Rre), slopewash (Rrs), or slopewash and colluvium (Rrsc)
- Bedrock and slopewash deposits with minor components of colluvium (Rsc), colluvium and residuum (Rscr), residuum (Rsr), or residuum and colluvium (Rsrc)

Water—Areas covered by water in lakes, reservoirs, perennial streams, and rivers

- Water

MAP SYMBOLS

Lineament Location

- Linear feature observable in aerial photography and/or stereo imagery

Fault Location

- Normal fault, approximate location, confirmed in the field or from aerial photography and stereo pair imagery; bar and ball on downthrown block
- Normal fault, inferred location based on traces of identified fault locations; bar and ball on downthrown block

South Granite Mountains fault system, Green Mountains section—The Green Mountains section of the South Granite Mountains fault system is a Pleistocene-Quaternary-age normal fault on the northern flank of the Green Mountains. This section of the fault extends for approximately 24 km with an average strike of N 79° W, dipping northeast. Dip along the fault is steep, but unmeasured and believed to be normal-sense reactivation of an Eocene-age thrust fault. The slip rate is determined to be less than 0.2 mm/year, and the recurrence interval is unknown (Machette, 1999a). The Green Mountains section of the South Granite Mountains fault system is considered by the U.S. Geological Survey to be a Class A fault, denoting observable displacement in Quaternary alluvial fans and/or terrace deposits.

South Granite Mountains fault system, Muddy Gap section—The Muddy Gap section of the South Granite Mountains fault system is a Pleistocene-Quaternary-age normal fault on the northern flank of the Red Hills and the western Ferris Mountains. This section of the fault extends for approximately 21 km with an average strike of N 64° W, dipping northeast. Dip along the fault is steep, but unmeasured and believed to be normal-sense reactivation of an Eocene-age thrust fault. The slip rate is determined to be less than 0.2 mm/year, and the recurrence interval is unknown (Machette, 1999b). The Muddy Gap section of the South Granite Mountains fault system is considered by the U.S. Geological Survey to be a Class A fault, denoting observable displacement in Quaternary alluvial fans and/or terrace deposits.

South Granite Mountains fault system, Ferris Mountains section—The Ferris Mountains section of the South Granite Mountains fault system is a Pleistocene-Quaternary-age normal fault on the northern flank of the Ferris Mountains. This section of the fault extends for approximately 18 km with an average strike of N 68° W, dipping northeast. Dip along the fault is steep, but unmeasured and believed to be normal-sense reactivation of an Eocene-age thrust fault. The slip rate is determined to be less than 0.2 mm/year, and the recurrence interval is unknown (Machette, 1999c). The Ferris Mountains section of the South Granite Mountains fault system is considered by the U.S. Geological Survey to be a Class A fault, denoting observable displacement in Quaternary alluvial fans and/or terrace deposits.

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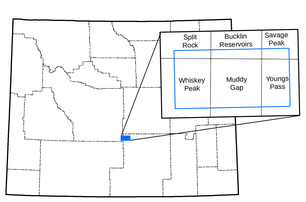

MAP LOCATION

Interpreting the past, providing for the future

Preliminary Surficial Map of the Muddy Gap Area, Carbon and Fremont Counties, Wyoming

By Seth J. Wittke and Ryan P. Fitzsimmons

Open File Report 2017-4
September 2017

Wyoming State Geological Survey

Thomas A. Drean, Director and State Geologist

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Layout by Christina D. George

Open File Report 2017-4
Wyoming State Geological Survey
Laramie, Wyoming: 2017

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INTRODUCTION

The primary purpose of this mapping project is to constrain valuable geomorphic and fault orientation data on the Muddy Gap segment of the South Granite Mountains fault system in central Wyoming. The map area includes portions of six 7.5' quadrangles: Split Rock, Bucklin Reservoirs, Savage Peak, Whiskey Peak, Muddy Gap, and Youngs Pass. The Muddy Gap area is located in northwestern Carbon and southeastern Fremont counties, Wyoming.

Portions of the proposed map area have been mapped at various scales and include bedrock geologic mapping by Weimer (1949), Reynolds (1968a, b), Love (1970), and Jones and others (2011). Surficial geologic mapping exists at 1:100,000 scale (Hallberg and Case, 2011); Case and others (1996) also extensively mapped landslides in the area at 1:24,000 scale. Geomatrix Consultant, Inc. (1988) includes the South Granite Mountains fault system in its Wyoming Basin Geomorphic Province Seismotectonic Evaluation.

Mapping was conducted through aerial imagery interpretation, including photogrammetric techniques and field examination of mapped units. Prior mapping was compiled and used as reference data to aid in mapping. Aerial interpretation was conducted on single-frame photographs dating from 1994 to 2004. All work pertaining to this publication was undertaken in 2016 and 2017.

This project was completed in cooperation with the U.S. Geological Survey (USGS) 2016 StateMap grant award G16AC00199. This map continues a long-term Wyoming State Geological Survey (WSGS) project to investigate poorly understood Quaternary faults in Wyoming and produce information regarding the hazards they pose.

PREVIOUS WORK

Reynolds created bedrock geologic maps for the Whiskey Peak and Muddy Gap 1:24,000 quadrangles (1968). He included the South Granite Mountains fault system as it extends northwest across the two quadrangles. Additionally, Witkind (1975) compiled faults in the northern Rocky Mountains that are known or suspected to be active. This includes the South Granite Mountains fault system, which Witkind (1975) labeled as having been recurrently active during the last 20 million years.

A detailed study of the Granite Mountains and the nearby geology was completed by J.D. Love (1970). Love mapped the bedrock geology and the South Granite Mountains fault system in the Muddy Gap area. Love identified the South Granite Mountains fault system as having originally been part of a fold and thrust belt created during the rise of the Granite Mountains to the north, and then reactivated as high-angle normal faults as the Granite Mountains subsided.

The USGS refers to the South Granite Mountains fault as Fault 779 and splits it into five sections based on primary research done by Geomatrix Consultants, Inc. (1988). These sections are the Crooks Mountain (779a), Green Mountains (779b), Muddy Gap (779c), Ferris Mountains (779d), and Seminoe Mountains (779e). Sections 779b, 779c, and 779d fall within the Muddy Gap map area. Additionally, all three sections are considered by the USGS to be Class A faults, which are faults with recognized Quaternary offset.

Geomatrix Consultants, Inc. (1988) completed a survey of the South Granite Mountains fault system that included the aforementioned Fault 779. Geomatrix Consultants, Inc.'s (1988) descriptions of the fault in the Muddy Gap area describe it as having several low scarps along the front of the Ferris Mountains that gradually decrease to the point of becoming indistinguishable from the near-vertical bedding of the bedrock to the west.

Surficial geologic mapping exists at 1:100,000 scale (Hallberg and Case, 2011), however, this map does not include the trace of the South Granite Mountains fault. Case and others (1996) also mapped landslides in the area at 1:24,000 scale.

LOCATION AND GEOLOGIC SETTING

The Muddy Gap area is bounded by the Granite Mountains to the north, the Ferris Mountains to the east, and Whiskey Peak and Green Mountain to the west. Quaternary faulting in the area is thought to be reactivation of the South Granite Mountains fault system (Love, 1970). The fault system originated as a thrust belt during the Eocene, contemporaneous with the rise of the Granite Mountains, with an estimated maximum vertical displacement of 900 m (3,000 ft). After a period of dormancy, the South Granite Mountains fault system reactivated in the normal sense and dropped the head wall a minimum of 600 m (2,000 ft) beginning in the Pliocene (Love, 1970). The South Granite Mountains fault system extends east-west for approximately 130 km (80 mi) and has an average strike of 290° (Witkind, 1975). Normal faulting continues to occur along the fault into the Holocene.

Bedrock Geology

Proterozoic

Proterozoic rocks in the Muddy Gap area are found primarily in the Ferris Mountains, east of Whiskey Gap, in normal contact with the overlying sedimentary rocks, and in fault contact with the sedimentary rocks along the trace of the South Granite Mountains fault system, west of Whiskey Gap (Weimer, 1949). The Proterozoic rocks primarily consist of fine-grained hornblende granite and are white to pink away from the South Granite Mountains fault. At the fault, the granite is highly weathered, brown, and coarse grained. Hydrothermal alteration has replaced much of the hornblende with limonite. Mafic dikes are present throughout the Proterozoic rocks of the Muddy Gap area (Weimer, 1949; Dickey, 1962).

Paleozoic

The Paleozoic rocks in the Muddy Gap area are composed of five formations: Flathead Sandstone, Madison Limestone, Amsden Formation, and Tensleep Sandstone. The Goose Egg Formation was deposited during the Permian and Triassic (Weimer, 1949; Dickey, 1962).

Mesozoic

The Mesozoic rocks in the Muddy Gap area are composed of the Chugwater Formation, Nugget Sandstone, Sundance Formation, Morrison Formation, Cloverly Formation, Thermopolis Shale, Mowry Shale, Frontier Formation, Cody Shale, Mesaverde Formation, Lewis Shale, Fox Hills Sandstone, and Lance Formation (Weimer, 1949; Dickey, 1962).

Cenozoic

The Cenozoic rocks in the Muddy Gap area include unnamed conglomerates and sandstones, and the Ogallala, Split Rock, Battle Spring, and Fort Union formations (Weimer, 1949; Dickey, 1962).

Surficial Geology

Surficial units in the Muddy Gap area described by Case and others (2011) include alluvium, alluvial fans, benches, terraces, eolian deposits, landslides, mesas, playa lakes, slopewash, colluvium, residuum, bedrock outcrop, and water (Hallberg and others, 2011).

Quaternary-age Faults

The Muddy Gap fault section is named for the town of Muddy Gap and the geographic feature of the same name (Machette, 1999b).

The South Granite Mountains fault is considered to be a normally (down to the north) reactivated Eocene reverse fault. The fault spans the southern edge of the Granite Mountains. The Granite Mountains are part of the Sweetwater

Arch, a Laramide-age west-northwest asymmetric anticline consisting of Precambrian granitic rocks and Pliocene/Miocene basin fill sediments (Love, 1970).

The South Granite Mountains fault section trends west-northwest along a range of mountains, including Crooks Mountain in the west and the Seminoe Mountains in the east. The fault system is broken into five sections. From west to east, they are: Crooks Mountain, Green Mountains, Muddy Gap, Ferris Mountains, and Seminoe Mountains (Machette, 1999a, b, c).

Mapped offset along the Muddy Gap section is restricted to the eastern portion of the segment near Cherry Creek and the transition to the Ferris Mountains segment. Geomatrix Consultants, Inc. (1988) notes the scarp becomes indistinguishable from vertical bedding in the central and western portions of the section. Through the completion of this mapping project, the authors of this publication suggest the western portion of the fault section can be inferred by lineaments and spring lines, although Holocene offset was not confirmed.

MAP DISCUSSION

Surficial deposits ranging from bedrock outcrop to alluvium exist across the map. As expected, the bedrock deposits are primarily found in the steeper terrains in the map. However, outcrop exists as secondary and minor unit components in shallower terrains as well, most notably south of the Red Hills in the central portion of the map. Bedrock outcrops, made up of Cretaceous-age Fox Hill and Mesaverde sandstones, are also found along Corral Creek, south of the western Red Hills.

Colluvium is mapped as a primary unit in the western Ferris Mountains and on the northern flank of Whiskey Peak. Colluvium deposits can also be found as a secondary and minor unit in the steeper areas of the Red Hills. Slopewash is prevalent throughout the map, however, it is notably prevalent north of the western Red Hills.

Alluvial fan deposits made up of fine to boulder-sized material dominate the areas of the map away from the mountain ranges. Based on elevation, fan size, and clast material, the fans can be inferred to encompass multiple formation ages. For the most part, fans emanating from Whiskey Peak contain granitic clasts and terminate at the Red Hills, although in the northwestern portion of the map, there is evidence that many of the fans extend beyond the Red Hills northward toward the Granite Mountains. The fans sourced in the Ferris Mountains contain some granitic and Paleozoic clasts. The oldest fans sourced in the Ferris Mountains appear to be cut by a late Tertiary-age fault that splits off the main South Granite Mountains fault (Love, 1970). Whiskey and Cherry creeks are the primary drainages of the Ferris Mountains and form large multistate alluvial fans.

Playas can be found in the central and southern-central portion of the map, within the Cretaceous-age bedrock outcrops. The playas also contain localized eolian deposits and small dune fields. The streams in the map area are made up of alluvial deposits and terraces.

Numerous landslides are found in the map area. In the eastern portion of the map, landslides are found primarily in the Jurassic and Triassic units and where alluvial fan deposits overly the Tertiary-age Fort Union Formation in the west. A large landslide is just west of Whiskey Peak along Whiskey Ridge. It is evident by a line of sag ponds along the southern boundary of the landslide. A large 2–3-m (7–10 ft) lateral scarp is located in the Tertiary-age Battle Spring Formation and boulder beds at the eastern boundary of the feature.

The Muddy Gap segment of the South Granite Mountains fault system runs northwest to southeast across the map area. The fault can be inferred west of the Red Hills from observable offsets in the Split Rock Formation and dispersed spring lines. Once the fault crosses Rawlins Draw, it becomes indistinguishable from the sub-vertical bedrock in the Red Hills. The fault has been mapped in various areas through the Red Hills by multiple authors. For the purpose of this publication, Reynolds' (1968a,b) trace of the South Granite Mountains fault system was

used between Rawlins Draw and Whiskey Gap. East of Whiskey Gap, the fault is mapped across colluvial aprons until it encounters Cherry Creek. East of Cherry Creek, the fault is considered to be part of the Ferris Mountains segment. Holocene offset along the mapped fault trace was unable to be determined. During the mapping of the fault trace, a lineament was noted along the northern flank of the Ferris Mountains. The lineament appears to offset a large colluvial apron and possibly a significant debris flow. The authors were unable to sufficiently investigate the lineament to determine whether it was related to the Muddy Gap fault segment. However, future investigations by the WSGS will provide more information about the lineament.

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