WYOMING STATE GEOLOGICAL SURVEY
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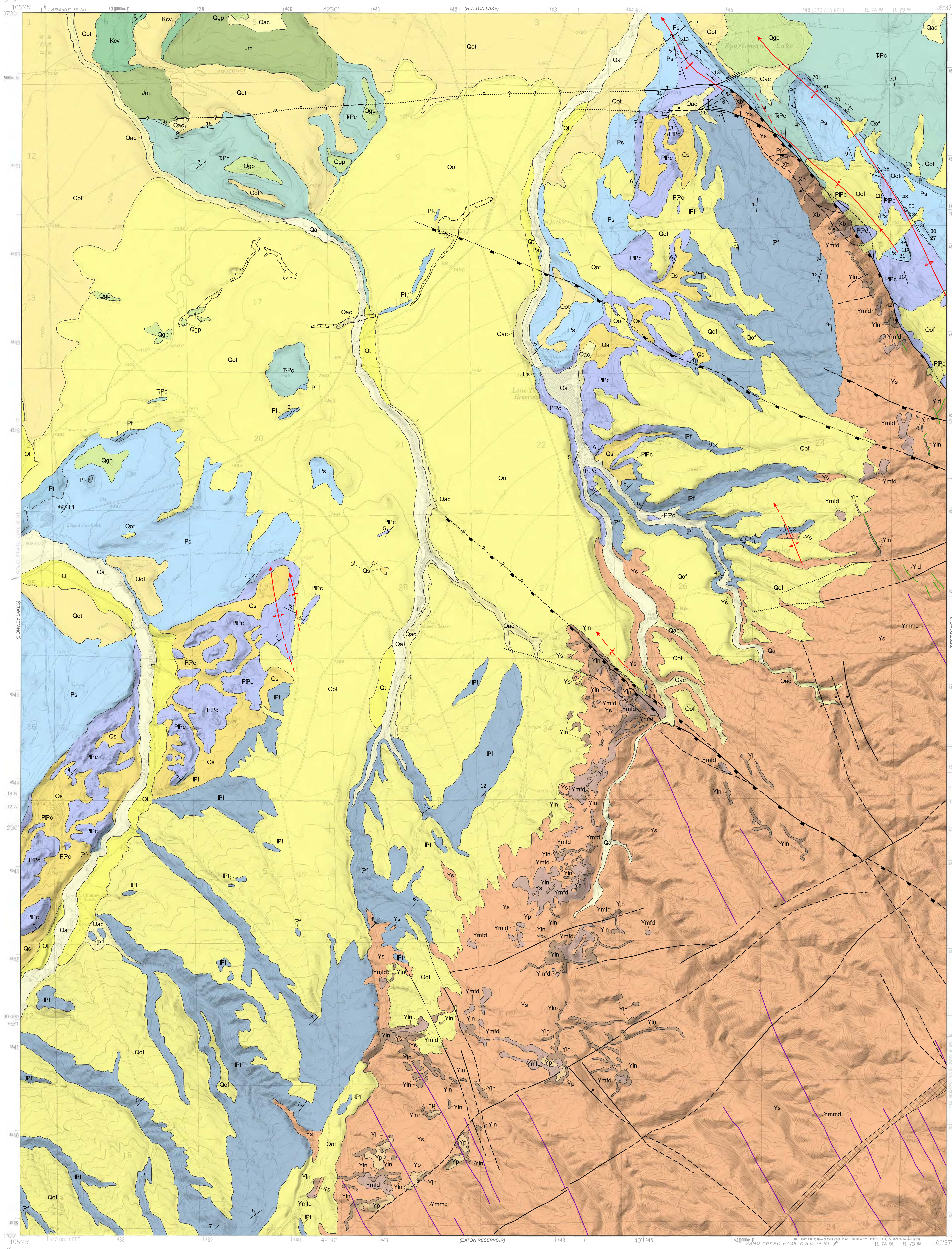
Laramie, Wyoming

Geology - Interpreting the past - providing for the future

Prepared in cooperation with the
U.S. GEOLOGICAL SURVEY

OPEN FILE REPORT 12-3
Johnson Ranch 1:24,000 - scale
Bedrock Geologic Map



Base map from U.S. Geological Survey 1:24,000 - scale topographic map of the Johnson Ranch, Wyoming Quadrangle, 1963, Photorevised 1978

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, east zone

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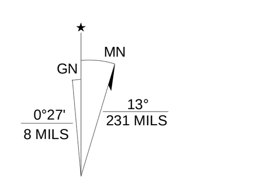
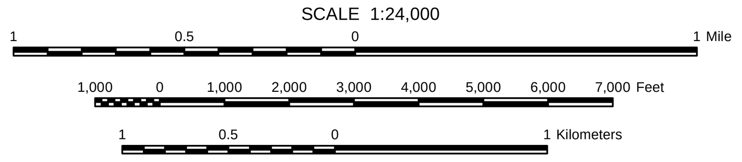
A digital version of this map is also available on CD-ROM

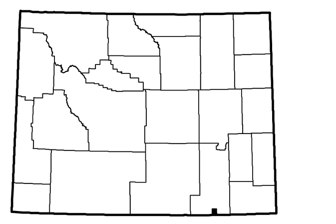


UTM GRID AND 1978 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24,000



CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929



WYOMING QUADRANGLE LOCATION

Digital cartography by Tom Ver Ploeg, Robin W. Lyons, and Kristen C. Klaphake

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 G11AC20493. 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 GEOLOGIC MAP OF THE JOHNSON RANCH QUADRANGLE, ALBANY COUNTY, WYOMING

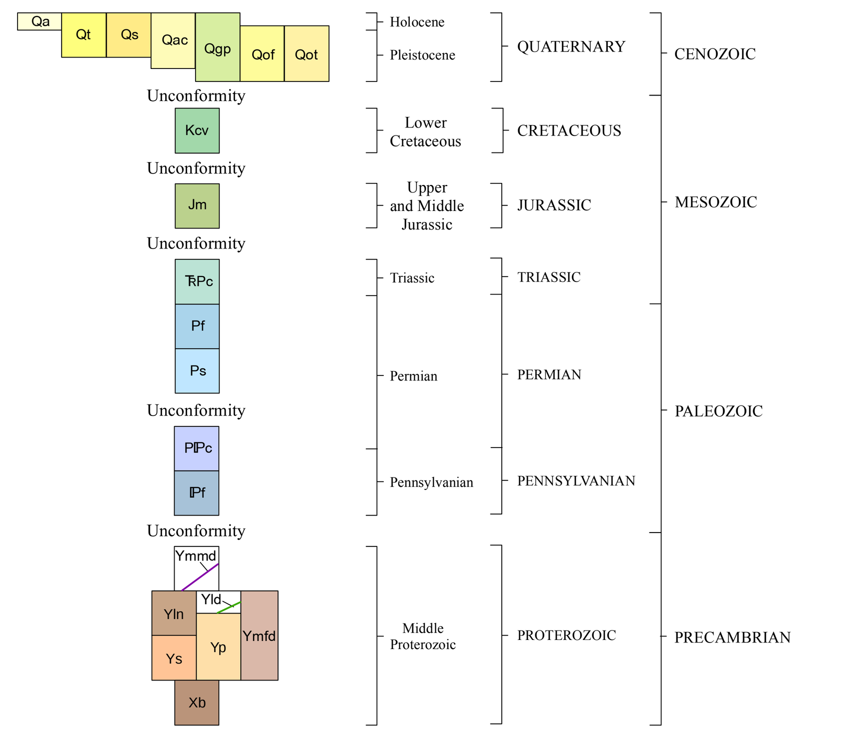
by

Alan J. Ver Ploeg, Davin A. Bagdonas, and J. Fred McLaughlin

2012

EXPLANATION

CORRELATION OF MAP UNITS



MAP SYMBOLS

Formation contact—Dashed where approximately located

Fault—Dashed where approximately located, dotted where concealed; block on hanging wall of reverse fault; bar and ball on downthrown block of normal fault; arrows indicate direction of oblique-slip movement

Fracture or possible fault—Dashed where approximately located, dotted where concealed

Fault zone—Characterized by brittle deformation; fault breccia, cataclastic material, and alteration is common

Anticline—Dashed where approximately located; arrow on end indicates direction of plunge; shorter arrow on asymmetrical structure indicates steeper limb, as determined by field measurements and aerial photo interpretation

Syncline—Dashed where approximately located, dotted where concealed; arrow on end or along axis indicates direction of plunge

Collapse structure

Sinkhole

Strike and dip of inclined bedding

Strike and dip of overturned bedding

DESCRIPTION OF MAP UNITS

Quaternary surficial deposits

Qa **Alluvial deposits (Holocene)**—Unconsolidated to poorly consolidated clay, silt, sand, and gravel, mainly in flood plains and lower stream terraces. Alluvial material is derived from all local geological units. Thickness approximately 0 to 50 feet (15 m) (Nicoll, 1963)

Qt **Terrace deposits (Holocene and Pleistocene)**—Beds of coarse sand and gravel with occasional boulders and lenses of silt and clay. Include fragments of weathered granite and limestone cobbles, predominance varies depending on feeding stream source. Occur along present drainages, a few feet (0.6 m) to over 35 feet (11 m) above modern floodplains. Thickness approximately 0 to 10 feet (3 m)

Qs **Windblown sand deposits (Holocene)**—Active and stabilized dunes, made up of very fine to fine-grained sand sourced by Casper Formation and Fountain Formation sandstones. Buff to gray to reddish, locally covered with patchy vegetation. Dunes are primarily deposited around vegetation, bedrock outcrops, and in small washes and topographic lows. Thickness 0 to 15 feet (5 m) (Nicoll, 1963)

Qac **Mixed alluvium and colluvium (Holocene and Pleistocene)**—Sand, silt, clay, and gravel deposited along intermittent streams; includes slope wash and smaller alluvial fan deposits that coalesce with alluvium. Thickness 0 to 50 feet (15 m) (Nicoll, 1963)

Qgp **Gypsite deposits (Holocene and Pleistocene)**—Unconsolidated clay-sized gypsum interbedded with red clay, sand, gravel, and limestone cobbles. Located in proximity to faults, probably related to fluid movement and erosion of gypsum beds of the lower Chugwater Formation and Satanka Formation. Thickness approximately 0 to 9 feet (2 m)

Qof **Older alluvial fan deposits (Pleistocene)**—Poorly sorted clay, silt, sand, and gravel; crudely bedded to non-bedded with some component of debris flow. Include boulders and cobbles of local geologic units. Currently inactive and dissected, often occurring as erosional remnants. Thickness 0 to 10 feet (3 m) (Nicoll, 1963)

Qot **Older terrace deposits (Pleistocene)**—Beds of course sand and gravel with occasional boulders and lenses of silt and clay. Resistant limestone and granite material occur as rounded, well-weathered boulders and gravels. Often occur as erosional remnants ranging from 20 to 300 feet (6 to 91 m) above present stream flood plains. Some remnants may actually be older alluvial fan remnants. Thickness 0 to 10 feet (3 m) (Nicoll, 1963)

Lower Cretaceous sedimentary rocks

Kcv **Cloverly Formation (Lower Cretaceous)**—Basal tan to white coarse-grained sandstone and chert pebble conglomerate, locally crossbedded and overlain by variegated buff and purple claystones interbedded with thin black shale beds, and an upper gray to buff to brown, fine- to coarse-grained sandstone, crossbedded in lower part of the formation. Thickness 100 feet (30 m) (Ver Ploeg and Boyd, 2007)

Jurassic sedimentary rocks

Jm **Morrison Formation (Upper and Middle Jurassic)**—Pale-green, olive-green, blue-green to maroon, and chalky white variegated calcareous and bentonitic claystones interbedded with thin drab limestones and buff, non-resistant sandstones. Limestone locally contains orange to brown chert inclusions. Includes about 50 feet (15 m) of Sundance Formation at the base; olive-drab, glauconitic sandstone and shale not mapable due to poor exposures. Thickness 350 feet (107 m) (Ver Ploeg and Boyd, 2007)

Triassic, Permian, and Pennsylvanian sedimentary rocks

TRPc **Chugwater Formation (Triassic and Permian)**—Red shale and siltstone with interbedded red to salmon to buff, fine-grained sandstone in upper part. Lower part of section contains red shale and calcareous siltstone, interbedded with thin to thick gypsum beds, local solution breccia, and banded wavy gypsiferous limestone sometimes mistaken as part of the Forelle Limestone. Includes approximately 150 feet (46 m) of Jelm Formation in upper section as a yellow to salmon-pink massive sandstone, with large-scale crossbedding, interbedded with thin partings of red siltstone, claystone, and shale. This unit was mapped separately by Vargas (1974). The lower part of the Chugwater Formation, along with the underlying Forelle Limestone and Satanka Shale, are mapped as Goose Egg Formation west of the Laramie Basin. Thickness 800 feet (244 m) (Ver Ploeg and Boyd, 2007)

Pf **Forelle Limestone (Permian)**—Gray to purple, thin-bedded, sparsely fossiliferous, resistant limestone locally interbedded with red siltstone and thin gypsum beds. Wavy outcrops of algal dome structure and more crinkly contorted bedding common (Nicoll, 1963). Crops out as low, broken, small ridges and highly fractured beds. Thickness 4 to 20 feet (1 to 6 m) (Nicoll, 1963)

Ps **Satanka Formation (Permian)**—Red siltstone and shale that is often banded with white and ocher color zones, and buff to orange to red fine-grained soft sandstone with distinct ripple marks common near the base of the unit. Gypsum occurs in the Satanka Formation as lenticular beds occurring as thick as 17 feet (5 m) (Darton and Siebenthal, 1909). Karst/sinkhole erosional structures associated with fluid flow in faults occur in the Satanka Formation on the northern portion of the map. Unconformably overlies the Casper Formation. Contact with Casper Formation can be difficult to discern though changes in grain angularity and the occurrence of ripple marks in the Satanka indicate the contact boundary. Thickness up to 260 feet (79 m) (Nicoll, 1963; Ver Ploeg and Boyd, 2007)

PPc **Casper Formation (Permian and Pennsylvanian)**—Buff to reddish, calcareous to quartzitic, very fine to course-grained, well-cemented sandstone interbedded with thin buff to purplish-gray limestone and dolomite beds, usually micritic and locally fossiliferous. Sandstone often exhibits large-scale festoon cross-bedding with siliceous fracture fill associated with faulting and local stresses. Within the map area siliceous-filled Casper Formation crops out as distinct resistant ridges, anchoring abundant vegetation and thick brush. Thickness is highly variable within the Laramie Basin, thinning toward the southwest. Within the map area thickness is 120 to 200 feet (37 to 61 m) (Maughan and Wilson, 1963)

Pf **Fountain Formation (Pennsylvanian)**—Coarse-grained pink to red to purple sandstone and arkose, with some conglomerates, fossiliferous limey sandstones, siltstones, shales, and thin limestone lenses. Blotchy pink-red iron staining is common on arkosic, resistant, ridge-forming portions of the formation. Conformably underlies Casper Formation within map area. Thickness is variable within the Laramie Basin, thickening toward the southwest. Within the map area thickness is 400 to 500 feet (122 to 152 m) (Nicoll, 1963)

Middle Proterozoic granitic and metamorphic rocks

Ymmd **Monzodiorite dike (Mg-rich)**—Fine-grained, brown to purple-black, highly fractured and weathered monzodiorite dikes that crop out linearly for several hundred feet to several miles (hundreds of meters to several kilometers) through the Sherman batholith. Dikes are predominately sub-vertical, which can be easily seen in the field as vertical to near vertical jointing within the dike. Monzodiorite dikes contain megacrystic alkali feldspars that display thin rims of plagioclase. Plagioclase xenocrysts associated with small, round quartz grains and hornblende are seen in random locations in the field (Frost and others, 1999). Two varieties of monzodiorite dikes have been recognized within the Sherman batholith that include an Fe-rich commingled body and an Mg-rich body that has less interaction with local country rock (Edwards, 1993). Mg-rich dikes are common within the map area. Monzodiorite dikes on the map area contain xenocrysts as described above, in addition to plagioclase and perthite that show obvious compositional zoning. Abundant, very small, needle-shaped apatite are pervasive throughout the sample and can be seen in thin section.

Major phases include plagioclase (some as myrmekite), perthite, microcline, biotite (sometimes altered to chlorite), hornblende, quartz, and orthoclase.
Minor phases include apatite, epidote, ilmenite, magnetite, and titanite.

The monzodiorite dikes have not been dated using modern isotope concordia methods. However, monzodiorite dikes cross cut Sherman Granite, Lincoln Granite enclaves and dikes, and porphyritic granite, indicating a post-Sherman batholith emplacement history.

Yld **Leucocratic dike**—Fine- to coarse-grained, sub-round to angular crystal structures of quartz, plagioclase and microcline with small amounts of mafic minerals. Some outcrops show localized mafic mineral concentrations along grain boundaries of primary quartz and plagioclase crystals. Leucocratic dikes range from fine to-small grained, pink-red, granitic, late stage batholith injections to coarse-grained, mature inner-grown crystal structures that consist of large quartz and alkali feldspar grains. Hydrothermal fluid alteration is evident in the larger crystal structure dikes as hematite staining and epidote. Alteration can also be seen as secondary, subgrain quartz growth within the larger crystal structure and especially along fractures within crystal faces

Major phases are plagioclase, quartz, microcline, perthite, and biotite
Minor phases are apatite, zircon, hornblende, ilmenite, and fluorite (Frost and others, 1999)

The age of the Leucocratic dikes is similar to that of the Lincoln Granite and in many cases the two are compositionally similar. The age of the fine-grained leucocratic dikes is assumed to be similar to the Lincoln Granite at 1,430 ± 2.6 Ma (Mega-annum or million years before present) by U-Pb dating (Frost and others, 1999). The age of the larger grained Leucocratic dikes is unknown, but field relationships suggest late stage batholith emplacement as a partially differentiated end member of the Sherman batholith

Yln **Lincoln Granite**—Medium- to fine-grained, equigranular, orange-red to orange-gray, biotite granite that crops out in horizontal sheets with resistant caps that create hills, domes, and high ridges that tend to outcrop above Sherman Granite. Some Lincoln Granite occurs as dikes and small inclusions/enclaves in the adjacent Sherman Granite. Lincoln Granite is generally less abundant than Sherman Granite. Lincoln Granite is a more evolved phase of the Sherman batholith with greater silica and less iron enrichment. The Lincoln Granite is classified as a ferroan alkali-calcic peraluminous granitoid (Frost and Frost, 2010). Contacts with the Sherman Granite are generally sharp. Contacts with the porphyritic granite are mingled to sharp. The Lincoln Granite was named after the Lincoln Monument that is present on the summit of the old Lincoln Highway and Interstate 80 (Edwards, 1993).

Major phases are quartz, plagioclase, microcline, perthite, biotite, hornblende, and ilmenite.
Minor phases are apatite, zircon, myrmekite.

Locally along fractures and faults the Lincoln Granite includes very small needle-like apatite along with titanite, epidote, and minor hematite and chlorite as alteration products. Some samples include isolated alkali feldspar megacrysts that make up less than 1% of the rock (Frost and others, 1999). The Lincoln Granite has been dated at 1,430 ± 2.6 Ma by U-Pb dating (Frost and others, 1999)

Ymfd **Mafic bodies, pods, and dikes (Fe-rich)**—Fe-rich mafic bodies, pods, and dikes occur throughout the map area within the Sherman batholith. They are strongly commingled with local porphyritic granite and Lincoln Granite and are generally emplaced as enclave-like dike features. Some field samples contain small inclusions of Sherman Granite as well as megacrystic plagioclase. In thin section the megacrystic plagioclase appear to be xenocrysts. Field relationships suggest dike/pod emplacement during batholith cooling.

Major phases include plagioclase, perthite, biotite, quartz, and orthoclase.
Minor phases are titanite, apatite, ilmenite, magnetite and zircon.

The mafic bodies, pods, and dikes have not been directly dated using modern isotope methods. Field relationships as described above suggest a later intrusive age to the Sherman Granite and similar age to Lincoln and porphyritic granites in the range of 1,430 to 1,433 Ma (Edwards, 1993)

Yp **Porphyritic granite**—Medium-grained, orange-gray to brown biotite hornblende granite with ½ to 1½ inch (1 to 4 cm), orange-pink and pink-gray perthitic microcline, and some plagioclase phenocrysts that show rapakivi-texture of plagioclase and quartz rims. Some outcrops of porphyritic granite show orientation of phenocrysts in a single stress direction that relates to local emplacement deformation. The porphyritic granite (named by Edwards, 1993) is considered a modal composition end member between the Sherman and Lincoln Granites (Frost and others, 1999). Hydrothermally altered outcrops have rapakivi texture where perthitic cores have altered to very fine grained, feathery masses of sericite. Epidote and minor chlorite are also seen as alteration products. Biotite exhibits moderate to heavy chloritic alteration with fine-grained, secondary quartz growth that de-laminates cleavage planes. Hematite-rich fluid is evident on crystal faces within the rock and is associated with cross-cutting quartz veins.

Major phases of the porphyritic granite are perthitic microcline, plagioclase, quartz, biotite, hornblende, and in hydrothermally altered samples, epidote and chlorite.
Minor phases include ilmenite, apatite, zircon, titanite, pigeonite, and in hydrothermally altered samples, sericite, hematite, and hydrothermally associated secondary quartz.

The porphyritic granite has been dated at 1,430 to 1,433 Ma by modal composition association between the Lincoln and Sherman Granites respectively (Frost and others, 1999)

Ys **Sherman Granite**—Medium- to coarse-grained, pink to reddish-orange, biotite hornblende granite that crops out in rounded to craggy mounds and more commonly a thick weathered grus. The Sherman Granite has a subporphyritic granular texture, exhibiting megacrystic microcline rimmed in plagioclase resulting in rapakivi texture in some locations. Sherman Granite is the most common phase of the Sherman batholith. It is the less evolved phase of the Sherman batholith with lower silica and greater iron concentrations. The Sherman Granite is classified as a ferroan alkali-calcic metaluminous granitoid (Frost and Frost, 1997). Contacts with both the Lincoln Granite and the porphyritic granite tend to be sharp.

Major phases are microcline, plagioclase, quartz, hornblende, biotite, and ilmenite.
Minor phases include zircon and apatite, and in some locations augite, pigeonite, and fayalite.

The Sherman Granite has been dated at 1,433 ± 1.5 Ma by U-Pb dating (Frost and others, 1999)

Xb **Garnet-biotite felsic gneiss**—Black to grayish-pink, fine-grained, feet (m)-scale folded, garnet-biotite felsic gneiss and biotite felsic gneiss. Composed of quartz, plagioclase, biotite, garnet, alkali feldspar, cordierite, and minor zircon, sphene, and chlorite. Very fine-grained biotite is interlayered with felsic bands rich in plagioclase, microcline, and quartz. Fine-grained biotite grains in mica-domains orient similar to elongate xenomorphic garnet. Garnet is common as poikioblasts in leucosome and quartzofeldspathic layers. Compositional banding parallels internal foliation of biotite. Banding forms isoclinal to tight folds with feet (m)-scale amplitude. Few inch (cm) parasitic folds on fold limbs are present. Unit is intruded by Sherman Granite and pigmatitic dikes related to late-stage Sherman batholith emplacement. Granitic intrusive material parallels banding and folding, parasitizing gneissic structure within the contact margin of the unit. Unit is interpreted as meta sedimentary rock syndepositional with metavolcanic gneisses described in relative proximity to unit and therefore of similar depositional age. Biotite felsic gneiss and garnet-biotite felsic gneiss have not been directly dated using modern isotope methods. Field relationship and comparative interpretation suggest an age ~1,743 to 1,610 Ma with the younger age preferred for metamorphic age (Jones, and others, 2010; Premo and Fanning, 2000)

Black to pinkish-gray to reddish, fine- to medium-coarse-grained biotite-hornblende felsic gneiss and biotite-hornblende augen gneiss occur as feet (m) scale lenses in garnet-biotite felsic gneiss and biotite felsic gneiss. Composed of quartz, plag0ioclase, alkali feldspar, biotite, and hornblende. Hornblende and biotite occur on rims of ¼ to ¾ inch (0.5 to 2 cm) quartz-feldspar porphyroclasts as augen and in very thinly banded mm-scale foliation layers. Based on outcrop study of fabric orientation, unit is most likely a metaigneous rock deformed at a similar age to garnet-biotite felsic gneiss and biotite felsic gneiss with a similar comparative age of ~1,743 to 1,610 Ma. It is unknown if this unit relates to younger deformed 1,433 Ma Sherman Granite that may have deformed during batholith emplacement

DISCLAIMERS

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