Interim Geologic Map of the West Mountain Peak Quadrangle, Washington County, Utah

by

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Description of Map Units

QUATERNARY

Alluvial deposits
Qah  
Alluvial-stream deposits (Holocene) – Moderately to well-sorted clay to boulder deposits in large active drainages; includes terraces up to 5 feet (1.5 m) above modern channels; mapped along Beaver Dam Wash and the lower reaches of Jackson Wash in the northwest corner of the quadrangle; 0 to 30 feet (0-9 m) thick.

Qat2-Qat3  
Alluvial-terrace deposits (Holocene to Pleistocene) – Moderately to well-sorted sand, silt, and pebble to boulder gravel that forms level to gently sloping surfaces above modern drainages; subscript denotes height above drainages; level-2 deposits are about 5 to 30 feet (1.5-9 m), level-3 deposits are 30 to 60 feet (9-18 m), level-4 deposits are 60 to 120 feet (18-37 m), and level-5 deposits are 120 to 180 feet (37-55 m) above modern drainages; deposited primarily in stream-channel and flood-plain environments; mapped along Beaver Dam Wash and Jackson Wash in the northwest corner of the quadrangle; map unit includes underlying Quaternary-Tertiary alluvial-pediment and basin-fill deposits (QTaPb) that cannot be differentiated along the steep margins of Beaver Dam Wash due to lithologic similarities; 0 to 30 feet (0-9 m) thick.

Colluvial deposits
Qc  
Colluvial deposits (Holocene to Pleistocene) – Poorly to moderately sorted, angular to subrounded, clay- to boulder-size, locally derived sediment deposited principally by slope wash and soil creep on moderate to steep slopes; locally includes talus and alluvial deposits too small to map separately; commonly included in mixed alluvial and colluvial deposits (Qac) along the edges of drainages and at the head of canyons; 0 to 20 feet (0-6 m) thick.

Mass-movement deposits
Qms  
Landslide deposit (Pleistocene) – Very poorly sorted, clay- to boulder-size, subangular to subrounded debris in chaotic, hummocky mounds; involves Triassic rocks from the Shinarump Conglomerate Member of the Chinle Formation along with the upper red and Shnabkaib Members of the Moenkopi Formation; sits on the Permian Pakoon Dolomite in the northeast corner of the quadrangle; 0 to 100 feet (0-30 m) thick.

Mixed-environment deposits
Qac, Qaco  
Mixed alluvial and colluvial deposits (Holocene to Pleistocene) – Poorly to moderately sorted, clay- to boulder-size, locally derived sediment; gradational with alluvial and colluvial deposits; younger material (Qac) is deposited in swales and minor active drainages whereas older deposits (Qaco) are younger
than and commonly derived from alluvial-pediment and basin-fill deposits (QTapb); older deposits form incised, inactive, gently sloping surfaces along minor active drainages that are similar to terraces along a major drainage; 0 to 30 feet (0-9 m) thick.

**Qeac**

**Mixed eolian and alluvial deposits with pedogenic carbonate soil (Holocene to Pleistocene) – Windblown sand, silt, and clay with minor alluvial deposits; bluish-white, stage V (Birkeland and others, 1991), laminated pedogenic carbonate (caliche) deposits with wrinkled bedding and well-developed pisoliths; eolian deposition is ongoing; map unit locally includes 0 to 5 feet (0-1.5 m) of yellowish-gray to light-olive-gray conglomerate of the underlying unit, that is generally better-cemented; forms isolated deposit on top of Quaternary-Tertiary alluvial-pediment and basin-fill (QTapb) deposits along the north edge of the quadrangle but becomes more extensive to the northwest and in the Terry Benches quadrangle to the southeast; 5 to 15 feet (1.5-4.5 m) thick.**

**QUATERNARY - TERTIARY**

**Alluvial deposits**

**QTapb**

**Alluvial-pediment and basin-fill deposits (Pleistocene to Pliocene) – Silt, sand, gravel, and boulder conglomeratic deposits derived mostly from Precambrian metamorphic and Paleozoic sedimentary rocks of the Beaver Dam Mountains, but also includes a variety of volcanic rocks derived from the Bull Valley Mountains to the north; forms extensive surfaces which slope toward Beaver Dam Wash, that are deeply incised, in some areas up to 300 feet (90 m); conglomerate is matrix or clast supported with poorly cemented, light-brownish-gray matrix of poorly sorted silt to angular, coarse sand; clast size ranges from pebbles to large boulders and clasts are subangular to rounded; usually forms a slope, which is steeper and more resistant where clast supported; commonly includes pedogenic carbonate surfaces, not mapped separately, that are not part of the broad, elevated surface mapped as mixed eolian and auvial deposits (Qeac); maximum exposed thickness is 300 feet (90 m).**

**Mass-movement deposits**

**QTms (Mr)**

**QTms (Dm)**

**QTms (Cbk)**

**QTms (Ct)**

**Landslide deposits (Pleistocene to Pliocene) – Detached gravity slide blocks of highly brecciated lower Paleozoic rocks that have moved down slope and have come to rest at the foot of the mountain (Cook, 1960); identity of source formation is indicated on the map in parentheses, but queried where brecciation makes identification questionable; where the base is exposed, a landslide detachment fault symbol is used to show the contact between these slide blocks.**

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and their underlying unit; a simple contact line is used locally where the basal parts of the slide blocks are buried by alluvial-pediment and basin-fill deposits or mixed alluvial and colluvial deposits; timing of emplacement is poorly constrained, but seems to coincide with deposition of QTaph; slide masses are 10 to 40 feet (3-12 m) thick.

unconformity

TERTIARY

Tmc Muddy Creek Formation (Pliocene to Miocene) – Shown on cross section only.

unconformity

JURASSIC

Jk Kayenta Formation (Lower Jurassic) – Dark-brownish-red, friable siltstone interbedded with medium-brownish-red, fine-grained, thinly bedded, cross-bedded sandstone with ripple marks and very dark brown desert varnish; discordant gypsum stringers fill fractures; forms step-slope topography; partially exposed in the north-central part of the quadrangle; exposed thickness about 630 feet (190 m).

unconformity

JURASSIC-TIASSIC

JTm Moenave Formation (Lower Jurassic to Upper Triassic) – Although too thin to map as members, both the Whitmore Point and the underlying Dinosaur Canyon Members are present in the north-central part of the quadrangle. Whitmore Point Member consists of interbedded, pale-reddish-brown, greenish-gray, and grayish-red mudstone and claystone, with thin-bedded, moderate-reddish-brown, very fine to fine-grained sandstone and siltstone; siltstone is commonly thin bedded to laminated in lenticular or wedge-shaped beds; claystone is generally flat bedded; contains several 3- to 12-inch-thick (7-32 cm), bioturbated, cherty, very light gray to yellowish-gray dolomitic limestone beds with algal structures, some altered to jasper, and fossil fish scales of Semionotus kanabensis; forms poorly exposed slope; upper unconformable contact is placed at the base of the dark-brownish-red sandstone ledge of the Kayenta Formation; deposited in low-energy lacustrine and fluvial environments (DeCourten, 1998); about 20 feet (6 m) thick. Dinosaur Canyon Member is uniformly colored, interbedded, generally thin-bedded, moderate-reddish-brown to moderate-reddish-orange, very fine to fine-grained sandstone, very fine grained silty sandstone, and lesser siltstone and mudstone; ripple marks and mud cracks common; forms ledgy slope; the contact between the Dinosaur Canyon and Whitmore Point Members
is gradational; deposited on broad, low flood plain that was locally shallowly
flooded by water (fluvial mud flat and lacustrine) (DeCourten, 1998); 110 to 140
feet (34-43 m) thick. Combined thickness of Whimere Point and Dinosaur
Canyon Members is 130 to 160 feet (40-50 m).

unconformity (J-0)

TRIASSIC

Chinle Group

[Note, in a departure from traditional nomenclature used in southern Utah, the
Chinle is herein considered a group following Lucas (1993). This change is
currently under consideration, and may or may not be adopted over the next few
years.]

Trecp  Petrified Forest Formation (Upper Triassic) – Not well exposed within this
quadrangle except for a few small outcrops of a purplish-gray, medium-grained
sandstone with subrounded grains, which contains locally abundant, brightly
colored fossilized wood, especially near the contact with the underlying
Shinarump Conglomerate; mudstone weathers to a “popcorn” surface of
somewhat pesty, purplish-gray to light-gray soils with desiccation cracks up to
2 inches (5 cm) wide; weathers to badland topography and is mostly slope
forming; upper unconformable contact corresponds to a color change between
the purplish mudstone below and the moderate-reddish-brown, fine-grained
sandstone of the Moenave Formation above; to the east of St. George, the
Petrified Forest Formation is highly variegated, light-brownish-gray, pale-
grenish-gray, to grayish-purple bentonitic shale, mudstone, siltstone, and
claystone, with lesser thick-bedded, resistant sandstone and pebble to small
cobble-size chert and quartzite conglomerate near base (Hayden, 2004);
deposited in lacustrine, floodplain, and braided-stream environments (Dubiel,
1994); 575 feet (175 m) thick.

unconformity

Tacs  Shinarump Conglomerate (Upper Triassic) – Varies from grayish-orange to
moderate-yellowish-brown, medium- to coarse-grained sandstone with locally
well-developed limonite bands (“picture stone” or “landscape rock”) to
moderate-brown pebble conglomerate with subrounded clasts of quartz,
quartzite, and chert; mostly thick- to very thick bedded with both planar and
low-angle cross-stratification; contains locally abundant, poorly preserved
petrified wood; steep dip creates fractured, prominent ridges of resistant
sandstone; slickenside surfaces common; weathered surface forms a dark-
grayish-brown desert varnish; upper contact is placed between the yellowish-
brown sandstone and pebbly sandstone of the Shinarump Conglomerate below
and the base of the varicolored bentonitic mudstone beds of the Petrified Forest
Formation above; variable in composition and thickness because it represents stream-channel deposition over Late Triassic paleotopography (Dubiel, 1994); generally 100 to 225 feet (30-70 m) thick.

_unconformity (TR-3)

**Moenkopi Formation**

**Tsum Upper red member** (Middle? and Lower Triassic) – Moderate-reddish-brown, thin-bedded siltstone and very fine grained sandstone with some thin gypsum beds and abundant discordant gypsum stringers; ripple marks, both asymmetrical and parallel symmetrical, are common in the siltstone; forms a steep slope with a few sandstone ledges; vertical fractures along two axes can make the top of a well-exposed sandstone bed resemble a stretched checkerboard; upper contact is based on distinct lithologic changes between the ledges of moderate-reddish-brown siltstone and sandstone of the upper red member below and the cliff of moderate-yellowish-brown sandstone of the Shinarump Conglomerate above; deposited in coastal-plain and tidal-flat environments (Dubiel, 1994); ranges from 200 to 375 feet (60-115 m) thick.

**Tums Shnabkaib Member** (Lower Triassic) – Differs greatly from its type section at Shinob Kibe Butte to the east near Washington City (Hayden, 2004); the Shnabkaib Member in the West Mountain Peak quadrangle contains more limestone, far fewer red beds, and is more resistant, forming step-slope topography and rounded hills. Divisible into five informal units, in ascending order:

1. basal unit of light-gray to pale-red, friable, gypsiferous siltstone with bedded gypsum, having the characteristic "bacon-striped" pattern;
2. light-brownish-red to light-yellowish-gray ledge-forming limestone with trilobid stems;
3. interbedded, slope-forming, yellowish-gray siltstone and ledge-forming, medium-yellowish-gray micritic limestone, including at least five distinct ledge formers, some over 8 feet (2.5 m) thick; topographic expression and rock characteristics of this limestone unit are very similar to the Virgin Limestone Member; forms bulk of Shnabkaib Member;
4. unit with characteristic "bacon-striped" pattern of interbedded, slope-forming, friable, reddish-brown gypsiferous siltstone and slope-forming, friable, grayish-white gyspiferous siltstone and limestone, with the grayish-white beds about twice as thick as the reddish-brown beds; and
5. very gypsiferous upper unit that weathers to a powdery soil commonly covered by microbiotic crust.

Upper gradational contact, marked by a prominent color change and lesser slope change, is placed at the top of the highest light-colored, thick gypsum bed, above which are steeper slopes of laminated to thin-bedded, moderate-reddish-brown siltstone and sandstone of the upper red member; deposited on a broad, shallow coastal shelf of very low relief where minor fluctuations in sea level
produced interbedding of evaporites, limestone, and red beds (Dubiel, 1994); generally 500 to 775 feet (150-235 m) thick.

Ttmm Middle red member (Lower Triassic) – Interbedded moderate-red to moderate-reddish-brown siltstone, mudstone, and thin-bedded, very fine grained sandstone with thin interbeds and veinlets of greenish-gray to white gypsum; poorly exposed and very weak, forming a U-shaped strike valley between the steeply dipping limestone ledges of the Virgin Limestone below and the Shnabkaib Member; upper contact is placed at the base of the first thick gypsum bed where the moderate-reddish-brown siltstone below gives way to banded, greenish-gray gypsum and pale-red siltstone above; deposited in tidal-flat environment (Dubiel, 1994); commonly attenuated; 100 to 300 feet (30-90 m) thick.

Ttmv Virgin Limestone Member (Lower Triassic) – Three distinct medium-gray to yellowish-brown limestone ledges interbedded with nonresistant, moderate-yellowish-brown, muddy siltstone, pale-reddish-brown sandstone, and light-gray to grayish-orange-pink gypsum; limestone beds are typically 5 to 10 feet (1.5-3 m) thick and contain five-sided crinoid columnals and *Composita* brachiopods; upper contact is drawn at the top of the highest limestone bed; deposited in shallow-marine environment (Dubiel, 1994); commonly attenuated; generally 250 to 500 feet (75-150) thick.

Txml Lower red member (Lower Triassic) – Moderate-reddish-brown siltstone, mudstone, and fine-grained, slope-forming sandstone; generally calcareous with interbeds and stringers of gypsum; ripple marks and small-scale cross-beds are common in the siltstone; only present in two locations above the unconformity with the Harrisburg Member of the Kaibab Formation; upper contact drawn at the color change from moderate-reddish-brown siltstone of the lower red member to moderate-yellowish-brown, muddy siltstone, usually about one foot (30 cm) thick, which underlies the base of the first limestone ledge of the Virgin Limestone Member; deposited in tidal-flat environment (Dubiel, 1994); 0 to about 40 feet (0-12 m) thick.

unconformity (Tr-1)

PERMIAN

Kaibab Formation

Pkh Harrisburg Member (Lower Permian) – Interbedded thin- to very thick bedded gypsum, gypsiferous mudstone, and limestone, some of which contains chert; laterally variable; mostly slope-forming, but includes a resistant, cliff- and ledge-forming medial white chert and limestone interval; Late Permian to Early Triassic subaerial erosion created significant topography on the Harrisburg Member in Washington County, although in this map area, the member remained topographically high as evidenced by the lack of deposition of the Rock Canyon Conglomerate or Timpoweap Members of the Moenkopi
Formation and the thinness of the lower red member; upper contact is unconformable with the lower red member of the Moenkopi Formation, or, where that member is not present, the Virgin Limestone Member of the Moenkopi Formation; deposited in a complex sequence of sabkha and shallow-marine environments (Nielson, 1981): 400 to 500 feet (120-150 m) thick.

**Ptf**  
**Fossil Mountain Member (Lower Permian) –** Light-gray, thick-to-very thick bedded, planar-bedded, laterally consistent, cherty limestone and fossiliferous limestone; whole silicified brachiopods abundant near top; calcite stringers fill fractures; “black-banded” due to abundant reddish-brown, brown, and black chert; forms prominent cliff with “meringue-like” weathering; upper conformable contact drawn at the break in slope between the limestone cliff of the Fossil Mountain Member and the gypsiferous mudstone and gypsum slope of the Harrisburg Member; deposited in shallow-marine environment (Nielson, 1986); 500 to 750 feet (150-230 m) thick.

**Toroweap Formation**

**Ptw**  
**Woods Ranch Member (Lower Permian) –** Grayish- to yellowish-orange gypsiferous siltstone with thin interbeds of white gypsum and light-gray to pale-orange limestone and dolomite; recessive slopeformer below the massive cliff of Fossil Mountain Member of the Kaibab Formation; in this area and near Red Hollow to the north, some of the gypsum has been dissolved and calcite and aragonite have been deposited in the lower portion (Nielson, 1986) in a process of calcitized anhydrite formation (Lucia, 1972); generally unfossiliferous except for fusulinids (Hammond, 1991) and poorly preserved brachiopods or algal stromatolites (Hastie, 1986) in the upper dolomite beds; upper contact placed at the change in slope at the base of the massive cliff of the overlying Fossil Mountain Member of the Kaibab Formation; deposited during shallow-marine regression (Nielson, 1986); thickness varies from 65 to 250 feet (20-75 m) because of dissolution and/or attenuation faulting.

**Ptb**  
**Brady Canyon Member (Lower Permian) –** Light-gray to pale-yellowish brown, fine- to medium-grained, thick- to very thick bedded limestone with common reddish-orange chert nodules and ribbon chert; base of member is dolomitic; brachiopods are common in the lower part with gastropod, coral, crinoid, bryozoan, and sponge fragments present throughout (Hinte, 1986); forms massive cliff to stair-step topography; upper contact is placed at the top of the massive cliff at the change in slope created by the recessive Woods Ranch Member; deposited by transgressive shallow sea (Nielson, 1986); thickness varies from 200 to 500 feet (60-150 m) probably because of attenuation faulting.

**Pts**  
**Seligman Member (Lower Permian) –** Grayish-orange gypsiferous siltstone interbedded with lesser white gypsum and light-olive-gray, fine-grained sandstone; as with the Woods Ranch Member, much of the gypsum has been altered and replaced by aragonite and calcite (Nielson, 1986); slope-former; upper contact drawn at the slope change at the base of the massive cliff of the
Brady Canyon Member; deposited during shallow-marine regression (Nielson, 1986); thickness varies from 80 to 150 feet (25-45 m) because of dissolution and/or attenuation faulting.

Pq Queantowap Sandstone (Lower Permian) – Very pale orange to grayish-orange-pink, fine- to medium-grained, thin- to thick-bedded, calcareous sandstone with festoon cross-bedding and cross-laminations; locally bioturbated (Nielson, 1986); upper contact is drawn at the top of the grayish-orange, cross-bedded sandstone that weathers to a ledge slope and at the base of the overlying yellowish-orange, gypsiferous, sandy siltstone that forms a slope; 1050 to 1750 feet (320-530 m) thick.

Pp Pakoon Dolomite (Lower Permian) – Light-gray, medium- to thick-bedded, fine-grained dolomite with chert nodules, which weathers to light-brownish-gray ledges and low cliffs; mostly unfossiliferous, but bryozoa and fusulinids occur in thin limestone beds interbedded with rare, ledge-forming sandstone in the upper part (Hintze, 1986); top 50 feet (15 m) is mostly gyspum with minor limestone and sandstone intervals; upper contact, which in this quadrangle coincides with an attenuation fault, is at the base of the massive sandstone of the Queantowap Sandstone, above the gyspum/limestone intervals of the Pakoon Dolomite; regional depositional thickness is 700 to 900 feet (213-275 m) (Hintze, 1986); structurally attenuated to 350 to 650 feet (105-200 m) thick.

PENNSYLVANIAN

IPc Callville Limestone (Upper to Lower Pennsylvanian) – Medium-gray, fine- to medium-grained, medium- to thick-bedded limestone with cyclic interbeds of moderate-orange-pink sandstone and light-gray dolomite increasing in the upper third; commonly cherty and fossiliferous; Lusnostreonella coral is common in upper part whereas brachiopods and bryozoa are common in limestone beds throughout (Hintze, 1985a); forms b-t-e-slope topography similar to the overlying Pakoon Dolomite; upper contact is placed at the base of the lighter-colored dolomite beds; regional depositional thickness 1500 to possibly 2000 feet (450-600 m) (Hintze, 1986); structurally attenuated to 350 to 1200 feet (105-365 m) thick.

unconformity

MISSISSIPPIAN

Mr Redwall Limestone (Lower Mississippian) – Medium- to dark-gray, very thick bedded, cherty, fossiliferous, cliff-forming limestone; in the Beaver Dam Mountains, the basal 60 feet (18 m) is coarse grained and dolomite, above which is an 80-foot-thick (25 m) cherty, bioclastic limestone that weathers to a dark yellowish-brown and probably correlates to the Thunder Springs Member of McGee and Gutschick (1969) as mapped by Steed (1980) in the Virgin River
Gorge south of the map area; upper 460 feet (140 m) is bioclastic, containing
born corals, colonial corals, and brachiopods (Hintze, 1985a); forms a massive
cliff that includes the top of West Mountain Peak; in the map area, the Redwall
Limestone is partially attenuated beneath the Callville Limestone; of the many
slide blocks of Redwall Limestone in the area (Hayden and others, 2005), only
one is present in the West Mountain Peak quadrangle along the south edge,
where it is partially buried by Quaternary-Tertiary alluvial-pediment and basin-
fill deposits (QTapb) and mapped as a Quaternary-Tertiary mass-movement
slide mass [QTms(Mr)]; structurally attenuated to 450 to 850 feet (135-260 m)
thick.

DEVONIAN

Muddy Peak Dolomite

Dm Muddy Peak Dolomite, undivided (Upper Devonian) – Used on map only to
identify slide block at bottom center of map where one side of the block is still
in contact with Precambrian rocks. Where blocks are partially buried by
Quaternary-Tertiary alluvial-pediment and basin-fill deposits (QTapb), label is
connected to Quaternary-Tertiary landslide label and queried where brecciation
makes identification of probable source formation difficult [QTms (Dm?)].

Dmp Pinnacle unit (Upper Devonian) – Light- to medium-gray, medium- to coarse-
grained, crystalline, very thick bedded dolomite with scattered chert nodules
and sandy laminae that weathers to form light-gray hoodoos or pinnacles below
the massive Redwall Limestone cliffs; 140 to 190 feet (45-55 m) thick.

Dms Slope unit (Upper Devonian) – Light-olive-gray to pale-yellowish-gray, fine-
grained, thin- to medium-bedded, silty dolomite that forms a ledgey slope;
includes small, silicified, stromatoporoidal structures as well as rare biothermal
mounds that include crinoid debris and scattered coral, gastropod, and
brachiopod fragments (Hintze, 1985b); upper contact drawn at base of the very
thick bedded, medium-gray dolomite that weathers to form pinnacles; 300
to 450 feet (90-135 m) thick.

unconformity

CAMBRIAN

Cn Nopah Dolomite (Upper Cambrian) – Light-gray to brownish-gray, fine- to
medium-grained, thick-bedded dolomite; contains algal stromatolites, small
tubular trace fossils (twiggy bodies), and mottled zones that suggest
bioturbation during deposition in a warm, shallow-marine environment
(Hammond, 1991); forms steep slopes to cliffs; upper unconformable contact is
drawn at the change to the more gentle slope of the slope unit of the overlying
Muddy Peak Dolomite; 1200 to 1400 feet (365-425 m) thick.
Bonanza King Formation (Upper to Middle Cambrian) – Medium- to light-brownish-gray, fine- to medium-grained, medium- to thick-bedded dolomite with some bluish-gray silty limestone beds in the lowest 300 feet (90 m) (Hintze, 1986); upper half consists of numerous thin beds of light-gray, very fine grained boundstone (Hammond, 1991); upper contact is drawn at the change in slope at the base of the steeper slope of the overlying Nopah Dolomite; several slide blocks [QTrns(Cbk)] are mapped from the center to the south edge of the map; Hintze (1985b) measured 2623 feet (800 m) along the north side of Horse Canyon; 2200 to 2600 feet (670-790 m) thick.

Bright Angel Shale (Middle to Lower Cambrian) – Olive-green, slope-forming, micaceous shale, siltstone, and fine-grained sandstone or quartzite with a ledge-forming, pale-brown-weathering, 10-foot-thick (3 m) dolomite about 125 feet (38 m) above the base and a 6-inch-thick (15 cm) limestone bed about 50 feet (15 m) below the top; no fossils have been reported in the Beaver Dam Mountains (Hintze, 1986); best exposures are in the southeast corner of the quadrangle; upper contact is gradational and drawn at the top of the predominantly shale and siltstone sequence above which are the limestone ledges of the Bonanza King Formation; locally thinned or absent due to attenuation faulting; 0 to complete thickness of 350 feet (6-105 m).

Tapeats Quartzite (Lower Cambrian) – Dark-reddish-orange to pale-reddish-brown quartzite with a few thin layers of quartz pebble conglomerate to metaglomerate and sandstone; thin to very thick bedded; generally forms ledges and dip slopes; upper contact is gradational and drawn where the quartzite gives way to the shale and siltstone sequence of the overlying Bright Angel Shale; commonly attenuated by faulting; several slide blocks [QTrns(Ct)] are mapped near the center of the quadrangle; Hammond (1991) reported a complete thickness of 1300 feet (400 m) near the north edge of the Jarvis Peak quadrangle to the southeast; attenuated thickness 720 to 800 feet (225-245 m).

unconformity

PRECAMBRIAN

Precambrian gneiss, schist, and pegmatite, undivided (Middle to Early Proterozoic) – Dark-gray dioritic gneiss consisting mostly of amphibole with about 10 percent each of feldspar, quartz, and pyroxene, interleaved with schist and pegmatite (Hintze, 1985a); dioritic gneiss is the most resistant and most extensively exposed rock type; schist contains principally either mica or amphibole with some plagioclase feldspar, quartz, garnet, and sillimanite (Reber, 1952); granite pegmatites are common and intrude both gneiss and schist; less common, white pegmatites are composed of 60 percent orthoclase and 25 percent quartz with some mica, plagioclase, and garnet (Hintze, 1986); numerous mining prospects are mapped near the south edge of the quadrangle;
exposed is a continuous belt about 8 miles (13 km) long and 4 miles (6 km) wide with at least 2500 feet (750 m) of relief. Although the age of Precambrian rocks in the Beaver Dam Mountains has not been determined, King (1976) compared them to the Vishnu and Braham schists of the Grand Canyon area, which are Middle Proterozoic age. Olimore (1971) reported a 1.7-billion-year K-Ar age (mineral not specified) on a pegmatite in similar Precambrian rocks in the East Mormon Mountains, Nevada, 15 miles (24 km) to the southwest, which would make those rocks Early Proterozoic. A nonconformity of approximately 1.2 billion years, referred to in the Grand Canyon as the “Great Unconformity,” separates the Precambrian rocks from the overlying Cambrian strata.

Structure

The complex structure of the area is discussed in detail by Reber (1952), Hintze (1986), Anderson and Barnhard (1993), Carpenter and Carpenter (1994), and O'Sullivan and others (1994). Only a short summary is given here. The study area includes the east flank and northward-plunging nose, as well as the truncated west flank, of the Precambrian-cored Virgin-Beaver Dam Mountains anticline, interpreted by Reber (1952) to be a Late Cretaceous Laramide-type compressional structure. However, the Beaver Dam Mountains anticline formed prior to being overridden by the Muddy Mountain-Tule-Square Top Mountain thrust, exposed to the north and west of the study area, during Late Cretaceous time between 97 to 70 million years ago (Carpenter and Carpenter, 1994). This suggests two separate phases of southeast-directed compression (Hintze, 1986).

Crustal extension in the area began in late Oligocene to early Miocene time (Carpenter and Carpenter 1994). In some cases, normal faults reactivated old zones of structural weakness inherited from both Precambrian rifting and Cretaceous compression, whereas other normal faults initiated as new zones of brittle failure (Anderson and Barnhard, 1993). Movement along these normal faults created the modern basin-range physiography and resulted in significant extension of the crust. In addition, the Virgin-Beaver Dam Mountains-Red Hollow normal fault system, which is listric in nature, has attained greater than 26,000 feet (8000 m) of vertical separation just south of the study area at the latitude of the Virgin Valley depocenter, which contains that thickness of Oligocene to Quaternary syntectonic clastic deposits shed from adjacent tilted horsts (Carpenter and Carpenter, 1994). Also associated with this vertical component of extension are rootless gravity slide blocks ranging from 10 to 40 feet (3-12 m) thick exposed along the western margin of the Beaver Dam Mountains and along the eastern Virgin Valley basin margin.

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**Map Symbols**

--- Contact – dashed where approximated

--- Normal fault – dashed where approximated, dotted where concealed, bar and ball on down-thrown side

--- High-angle fault (probably normal) – identified using geophysical data

--- attenuation fault – dashed where approximated, dotted where concealed, triangles on hanging-wall block

--- Landslide detachment fault bounding slide block - hachures on displaced block

3 2  Strike and dip of bedding

4 3  Strike and dip of overturned bedding

4 0  Strike and dip of foliation

Spring

Prospect
<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>IMPLEMENTED</th>
<th>MEMBER</th>
<th>FORMATION</th>
<th>SYMBOL</th>
<th>PHONETIC (hast Meters)</th>
<th>LITHOLOGY</th>
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<tr>
<td>Quaternary</td>
<td></td>
<td>winters</td>
<td>antiquity</td>
<td>QI</td>
<td>(Q000190)</td>
<td>point lakonic breccia, including biotite and biotite blocks</td>
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<td>(Q000150)</td>
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</tbody>
</table>

**Lithology**
- **glacial deposits**: predominantly biotite and biotite blocks.
- **surficial deposits**: biotite breccia and biotite blocks.
- **glacial deposits**: biotite breccia and biotite blocks.
- **middle reformation**: biotite breccia and biotite blocks.
- **middle reformation**: biotite breccia and biotite blocks.
- **upper reformation**: biotite breccia and biotite blocks.
- **middle reformation**: biotite breccia and biotite blocks.
- **lower reformation**: biotite breccia and biotite blocks.
- **post-glacial deposits**: biotite breccia and biotite blocks.