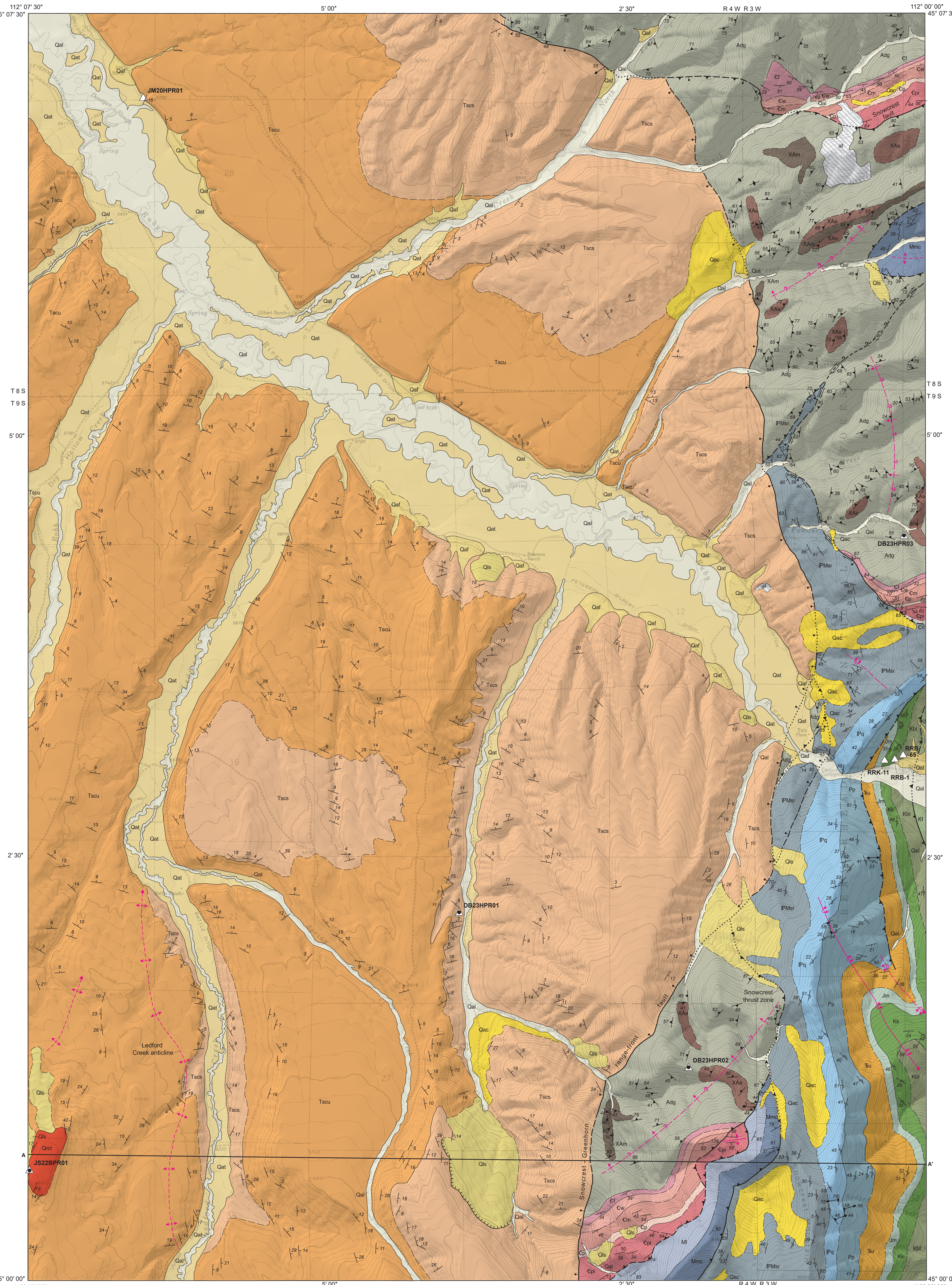


Base map produced by the United States Geological Survey
Home Park Ranch 1:24,000-scale quadrangle map
Control by: USGS and USC&GC
Compiled from aerial photographs taken 1961
Field checked: 1963
Projection: Polyconic
Vertical Datum: National Geodetic Vertical Datum of 1929
Horizontal Datum: 1927 North American Datum

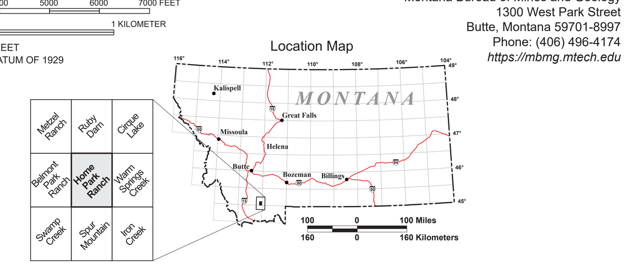
Shaded relief created from 10-meter digital elevation model from U.S. Geological Survey National Elevation Dataset.

UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET
0°45′ 13 MILS; 12°0′ 213 MILS

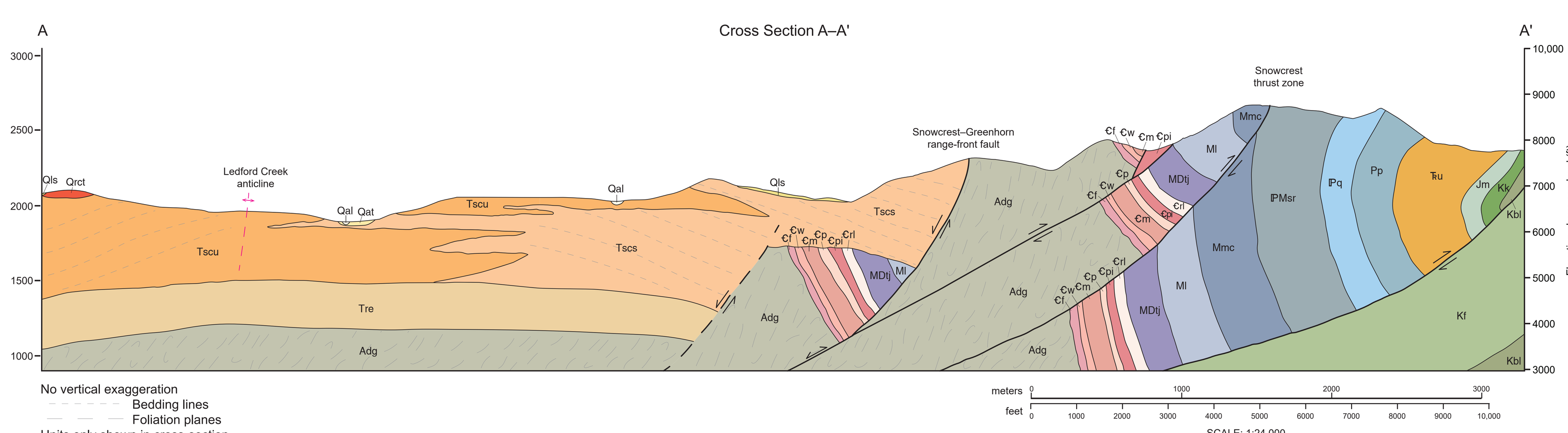
SCALE 1:24,000
CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Maps may be obtained from:
Publications Office
Montana Bureau of Mines and Geology
1300 West Park Street
Butte, Montana 59701-8997
Phone: (406) 496-4174
https://mbmg.mtech.edu

Location Map



Cross Section A–A′

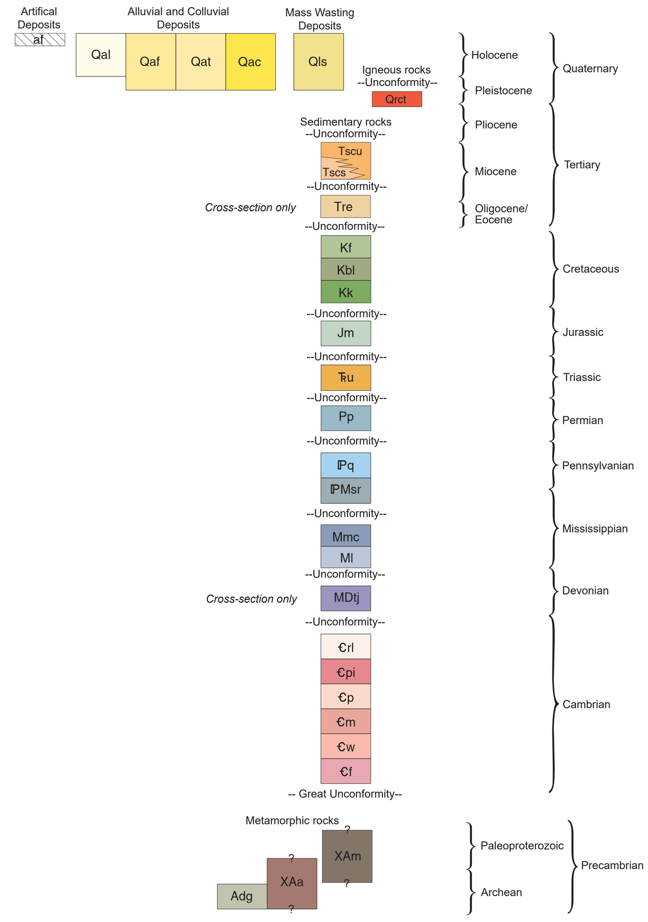


No vertical exaggeration
Bedding lines
Foliation planes
Units only shown in cross-section
Tre Renova Formation
MDtj Three Forks and Jefferson Formation, undivided

Depth of basin-fill was estimated using a well log (Montana Board of Oil and Gas API# 25057210040000) from adjacent Belmont Park Ranch 7.5′ quadrangle with approximately 775 m (2,540 ft) of undifferentiated Quaternary–Tertiary sediments resting on Precambrian metamorphic basement. Early gravity studies suggest closer to approximately 2,000 m (6,562 ft) of Tertiary basin-fill (Burfeind, 1967).

Research supported by the U.S. Geological Survey, National Cooperative Geologic Mapping Program, under USGS award G23AC00457.
GIS production: Daniel Brennan, Patricia E. Gallagher, and Yiwen Li, MBMG. Map layout: Susan Smith, MBMG. Editing: Susan Barth, MBMG.

CORRELATION CHART



MAP SYMBOLS

? = Identity or existence questionable

Contacts and faults	Accurate	Approximate	Inferred	Concealed
Contact				
Normal fault—Ball and bar on downthrown block				
Strike-slip fault, right-lateral offset—Arrows show relative motion				
Oblique-slip fault, right-lateral offset—Ball and bar on downthrown block				
Thrust fault—Sawteeth on upper (tectonically higher) plate				
Head or main scarp of landslide—Active, sharp, distinct, and accurately located. Hachures point down scarp				

? = Identity or existence questionable
Large arrowhead shows direction of plunge

Structure Lines				
Anticline				
Overturned anticline—Beds on one limb are overturned; arrows show dip direction of limbs				
Overturned syncline—Beds on one limb are overturned; arrows show dip direction of limbs				
Monocline—Arrow shows direction of dip				

Orientation Points

- Small, minor inclined joint—Showing strike and dip
- Inclined bedding—Showing strike and dip
- Overturned bedding—Showing strike and dip
- Inclined cleavage (generic or type unspecified)—Showing strike and dip
- Inclined flow banding, lamination, layering, or foliation in igneous rock—Showing strike and dip
- Inclined metamorphic or tectonic foliation—Showing strike and dip
- Vertical metamorphic or tectonic foliation—Showing strike
- Inclined slickenline, groove, or striation on fault surface—Showing bearing and plunge
- Horizontal slickenline, groove, or striation on fault surface—Showing bearing
- Inclined fold hinge of generic small, minor fold—Showing bearing and plunge
- Sample: Bulk-rock geochemistry
- Sample: U-Pb geochronology

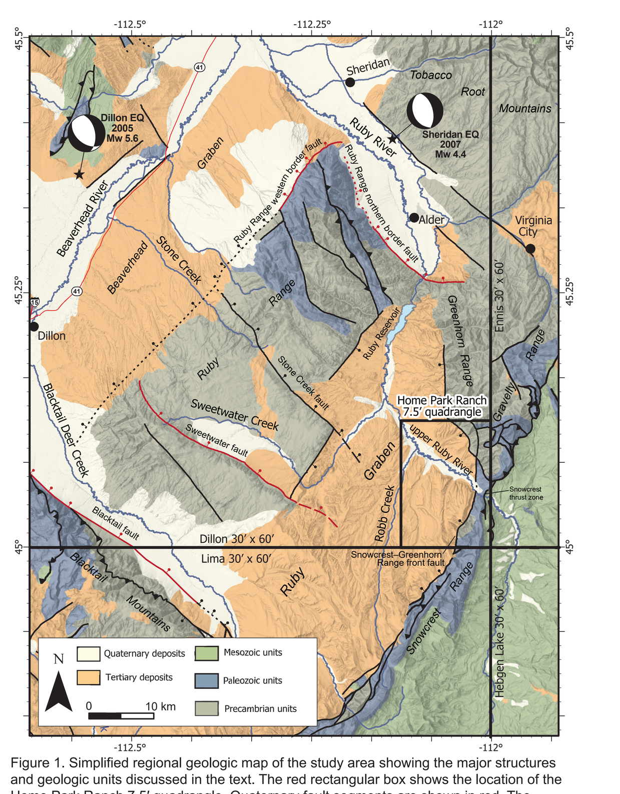


Figure 1. Simplified regional geologic map of the study area showing the major structures and geologic units discussed in the text. The red rectangular box shows the location of the Home Park Ranch 7.5′ quadrangle. Quaternary fault segments are shown in red. The geology is derived from the geologic map of the Dillon 1° x 2° quadrangle (Ruppel and others, 1993) and the Geologic Map of Montana (Vuke and others, 2007).

Table 1. U-Pb zircon geochronology

Sample	Lithology	Unit	Latitude (°N)	Longitude (°W)	Method	# Spot analyses[e]	Age (Ma)	2σ	MSWD
JS22BPR01	rhyolite	Qrct	45.0108	-112.1256	WM 206/238	8/40	1.9	0.1	0.3
JM20HPR01	tephra	Tcsu	45.1166	-112.1098	WM 206/239	26/40	9.3	0.1	0.6
DB23HPR01[a]	tephra	Tscs	45.0362	-112.0658	TuffZirc	12/40	10.7	0.4	-
RRB-65[b]	sandstone	Kbl	45.0517	-112.0040	MDA 206/238	174/569	104.3	0.2	1.0
RRB-1[c]	sandstone	Kbl	45.0513	-112.0052	N/A	0/518	-	-	-
RRK-11[d]	sandstone	Kk	45.0512	-112.0066	N/A	0/524	-	-	-
DB23HPR02	gneiss	Adg	45.0209	-112.0339	MEA 207/206	26/60	2658	15	4.6
DB23HPR03	gneiss	Adg	45.0734	-112.0038	MEA 207/206	19/60	2717	8	0.5

Note. Reported ages are the weighted mean of the ^{207}Pb corrected ^{206}Pb/^{238}U ages obtained for each sample. MSWD is the Mean Square Weighted Deviation. Zircon separates were prepared at MBMG and analyzed by LA-ICPMS at the University of California, Santa Barbara. Latitudes and longitudes are in the 1984 World Geodetic Survey (WGS84) datum.
Method: WM 206/238 weighted mean of select ^{206}Pb/^{238}U dates
MDA 206/238 max depositional age, weighted mean of youngest ^{206}Pb/^{238}U dates
MEA 207/206 maximum emplacement age, weighted mean of oldest overlapping ^{207}Pb/^{206}Pb dates
TuffZirc TuffZirc age (Ludwig, 2012)
[a]TuffZirc age reported due to overdispersion in WM 206/238.
[b]Data from Rosenblume and others (2021a), detrital apatite data reported by Finzel and others (2025).
[c]Data from Gardner and others (2022), no max depositional age interpeted due to lack of young grains.
[d]Data from Rosenblume and others (2021b), no max depositional age interpeted due to lack of young grains.
[e]Number of spot analyses used to calculate weighted mean age.

INTRODUCTION

The Home Park Ranch 7.5′ quadrangle is located in Madison County, Montana, approximately 45 km (28 mi) southeast of Dillon and 25 km (15.5 mi) south of Alder (fig. 1). The quadrangle comprises much of the southeastern portion of the upper Ruby River Valley, about 8 km (5 mi) south of the Ruby River Reservoir. The quadrangle is bounded to the east by the north-trending Greenhorn Range and to the south by the southwest-trending Snowcrest Range (fig. 1). These ranges both contain overlapping “thin- and thick-skinned” structures associated with crustal shortening during the Cordilleran Orogeny. The modern topography in the region generally reflects Cenozoic extension following the collapse of the thickened Cordillera from the Eocene to the present (Constenius, 1996). Exposure of bedrock geology in the Home Park quadrangle includes Archean to Paleoproterozoic metamorphic basement rocks, and Paleozoic to Mesozoic and Neogene sedimentary rocks.

PREVIOUS MAPPING AND METHODS

The Dillon 1° x 2° (1:250,000-scale) geologic map by Ruppel and others (1993) covers the Home Park Ranch 7.5′ quadrangle. Portions of the quadrangle are included in larger scale maps in the Greenhorn Range (Berg, 1979; 1:28,160-scale), Snowcrest Range (Sheedlo, 1984; 1:24,000-scale), and the western portion of the Ruby River Valley (Monroe, 1976; 1:24,000).

New geologic mapping in the Home Park Ranch 7.5′ quadrangle was conducted over one field season in 2023 as part of the U.S. Geological Survey (USGS) National Cooperative Geologic Mapping Program STATEMAP component. A 1:24,000-scale topographic base was utilized for field mapping. Geologic contacts were refined using the orthoimagery dataset produced by the National Agricultural Imagery Program (NAIP; 2018–2020). LiDAR data (https://apps.nationalmap.gov/lidar-explorer) were used to refine geologic contacts. Structure and observational data were located using a handheld GPS smartphone device (Apple iPhone 14); structure data were measured with a traditional Brunton hand transit compass or the same smartphone device utilizing the Fieldmove Clino program by Petroleum Experts. Field sheets were scanned and georeferenced in GIS software. The geologic data were subsequently digitized to the Geologic Map Schema (GeMS) geodatabase of the USGS National Cooperative Geologic Mapping Program.

Rock samples collected for whole-rock geochemistry and U-Pb geochronology were processed at the Montana Bureau of Mines and Geology (MBMG) mineral separation laboratory. An approximately 100- to 200-g split of the crushed material was prepared for bulk-rock geochemical analysis and subsequently analyzed by X-ray fluorescence (XRF) and inductively coupled plasma mass spectrometry (ICP-MS) at the Peter Hooper GeoAnalytical Lab, Washington State University. MBMG whole-rock geochemistry results are shown in figure 2 and available from Mosolf and others (2025i). Zircon was isolated from select specimens by standard density and magnetic separation techniques at the MBMG mineral separation laboratory. Zircon separates were then analyzed by laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS) at the University of California, Santa Barbara. MBMG zircon U-Pb geochronology results (Brennan and others, 2025; Mosolf and others, 2023; Mosolf and Kylander-Clark, 2023) along with previously published zircon and apatite U-Pb data from the map area (Rosenblume and others 2021a, b; Finzel and others, 2025) are shown in figure 3 and table 1.

GEOLOGIC SUMMARY

Precambrian metamorphic rocks are exposed in the Home Park Ranch quadrangle in both the Snowcrest and Greenhorn Ranges. These rocks consist of the Neoarchean, ca. 2.9–2.6 Ga, Dillon Gneiss (Adg) and intercalated amphibolite (XAa), marble (XAm), and localized talc bodies. Although there are no active talc mines in the Home Park Ranch quadrangle, the historic Willow Creek Talc Mine was active from 1970 to 1979 (Berg, 1979; Van Gosen and others, 1998; map unit af, sec. 30).

Transgressive lower Cambrian strata (Ꞓf, Ꞓw, Ꞓm) unconformably overlie the Neoarchean Dillon Gneiss (Adg) in both the Snowcrest and Greenhorn Ranges, denoting the “Great Unconformity” or an absence of approximately 2 billion years of the geologic record. A relatively complete section of Cambrian to Jurassic (Ꞓf through Jm) siliciclastic and carbonate strata is present but structurally dismembered, folded, and locally overturned. These strata record several marine incursions along the western margin of North America during the Paleozoic and early Mesozoic. Generally coarser Cretaceous strata (Kk and Kf) denote an influx of siliciclastic material from the west associated with the onset of Cordilleran orogenic deformation and the development of a foreland basin system in the region (Rosenblume and others, 2021a, b; Finzel and others, 2025). In the Late Cretaceous, Cordilleran thrust-belt deformation propagated into the map area, evident by contractional structures of the Snowcrest and Greenhorn thrust systems (Hadley and others, 1980; Sheedlo, 1984; Parker and Pearson, 2023), which displace both crystalline basement and the overlying Phanerozoic stratigraphy.

The Snowcrest–Greenhorn range-front fault bounds the west side of the Snowcrest and Greenhorn Ranges (Sheedlo, 1984) in the Home Park Ranch quadrangle, and accommodated extension and formation of the Tertiary Ruby Graben (fig. 1). Prior workers (Sheedlo, 1984) have noted that the Snowcrest–Greenhorn range-front fault closely flows the trace of the Snowcrest thrust zone, indicating it likely partially reactivated the thrust. In the northeastern portion of the quadrangle, a northwest-trending segment of Snowcrest fault (Hadley, 1969), a likely subsidiary structure of the Snowcrest thrust zone (Hadley and others, 1980; Sheedlo, 1984), offsets the northeast-trending Snowcrest–Greenhorn range-front fault, indicating local reactivation of this thrust fault in a normal sense. The reactivated northwest-trending segment of the Snowcrest fault is parallel to other normal faults in the Ruby Graben, such as the Blacktail and Sweetwater faults (fig. 1), which likely also reactivated older contractional structures (Crawford and Pearson, 2018; Mosolf and Sears, 2024). Extension in the Ruby Graben is recorded in the basin-fill deposits of Eocene to Miocene Renova Formation and middle to late Miocene Sixmile Creek Formation. In the Home Park Ranch quadrangle, the Renova Formation is inferred to be buried at depth beneath extensive Sixmile Creek Formation strata (see adjacent Home Park Ranch quadrangle; Brennan and others, 2024). Sixmile Creek lithologies include locally derived, angular cobble to boulder conglomerates near the range fronts mapped as the Sweetwater Creek member (Tscs). Near the basin-axis, far-travelled round cobble and gravel channel deposits and interbedded vitric reworked tuffaceous sandstone beds are more widespread. These lithologies have been previously assigned to the Big Hole River and Anderson Ranch members of the Sixmile Creek Formation (see Thomas and Sears, 2020) and are mapped as an undivided unit here (Tscu) following Brennan and others (2024).

In the Home Park Ranch quadrangle, the Sixmile Creek Formation (Tscs and Tscu) is gently folded (The Ledford Creek Anticline) around an axis plunging gently north to northeast (trending 10 degrees, plunging 6 degrees; fig. 4). This orientation is interpreted to reflect syndepositional faulting along the Snowcrest–Greenhorn range-front fault, a northeast-trending (approximately 15 to 30 degrees) listric fault with gentle tilting by mostly post-depositional northwest-trending (approximately 300 to 330 degrees) faults such as the Snowcrest fault. Following Sheedlo (1984), a half-graben block is inferred to underlie Sixmile Creek strata along the range front. To the south of this quadrangle, half-graben block(s) in similar structural positions crop out (Lonn and others, 2000). In the southwestern region of the map area, a rhyolitic tuff, the Robb Creek Tuff (Qrct; Garson, 1992), is dated at ca. 1.9 Ma and forms a small (~0.15 km², 0.06 mi²) resistant mesa. Modern alluvial (Qal, Qat, Qaf), alluvium and colluvium (Qac), and landslide (Qls) deposits, mostly associated with the upper Ruby River or its tributaries, locally cover the bedrock.

DESCRIPTION OF MAP UNITS

Anthropogenic Deposits

af **Artificial Fill (Quaternary: Holocene)**—Artificial human-made deposits composed of locally excavated and emplaced rock and gravel. Consists primarily of reclaimed mining rubble related to the Willow Creek Talc mining operation (sec. 30) and a smaller aggregate operation (sec. 5).

Quaternary Units

Qal **Alluvium (Quaternary: Holocene)**—Unconsolidated, well-rounded, poorly to well-sorted, cobble, gravel, sand, and silt deposited in active stream channels and perennial floodplains. Thickness generally less than 6 m (20 ft.)

Qaf **Alluvial Fan Deposits (Quaternary: Holocene)**—Unconsolidated, moderate to poorly sorted, locally derived deposits composed of silt and sand with sub-angular to sub-rounded boulder-sized clasts; deposits formed through debris flow and alluvial processes along valley margins and in tributary draws. Thickness as much as 30 m (100 ft).

Qat **Alluvial Terrace Deposits (Quaternary: Holocene)**—Unconsolidated, mostly rounded, poorly to well-sorted, cobble, gravel, sand, and silt deposited above active stream channels and floodplains on fluvial terraces that stand at slightly higher levels than modern channels. Thickness is generally less than 5 m (15 ft).

Qac **Quaternary Alluvium and Colluvium (Quaternary: Holocene)**—Unconsolidated, poorly sorted, boulders to silt sediments, often formed by underlying bedrock weathering in place and deposited by alluvial and hillslope creep processes. Thickness is generally less than 5 m (15 ft).

Qls **Quaternary Landslide Deposits (Quaternary: Holocene)**—Unconsolidated, unsorted and unstratified mixtures of proximally derived angular material, forming characteristic irregular hummocky topography, due to mass wasting and downslope movement. Some deposits may be currently or recently active as evidenced by limited denudation of head scarps. Variable thickness up to 15 m (50 ft).

Sedimentary And Volcanic Deposits

Qrct **Robb Creek tuff (Quaternary)**—Pinkish gray rhyolitic tuff (JS22BPR01, fig. 2); weathered surfaces have a pitted appearance. Contains sanidine phenocrysts with lithics of basalt, tuff, and pumice (all less than 4 cm, 1.6 in) generally flattened parallel to the base of unit, and supported in an aphanitic groundmass (Garson, 1992). Forms a small resistant mesa in the southwestern portion of the map area. Unit has a U-Pb zircon age of 1.9 ± 0.1 Ma (fig. 3, table 1) and is 3 to 4.5 m (10 to 15 ft) thick.

Tscu **Sixmile Creek Formation, undivided (late to middle Miocene)**— Predominantly coarse-grained, clast-supported conglomerate of the Big Hole River member interstratified with reworked tuffaceous Anderson Ranch beds. Bioturbation, Hemphillian-age vertebrate fossils, and soft sediment deformation are typical throughout the unit. Paleosol horizons are also present. Intraformational low-angle unconformities, clastic dikes, and syn-depositional fault and/or soft sediment compaction features are commonly observable, indicating rapid and/or tectonically active deposition. At least 300 m thick (984 ft).

Big Hole River member, informal—Black, green, red, pink, and white, well-rounded, polymictic cobble to pebble conglomerate, with lesser coarse-grained feldspathic and lithic sandstone intervals. Clasts are predominantly quartzite and argillite, with lesser chert and volcanics. Subordinate volcanic clasts (<20 percent) in lower stratigraphic intervals, generally rounded, and not accompanied with gneiss or schist basement clasts, distinguish the Big Hole River member from the Sweetwater member (fig. 5). Clastic grain sizes range from silt to cobbles (<25 cm, 10 in), with rare boulders (<40 cm, 16 in). Channelized bedforms are common, with abundant large-scale planar and festoon cross-bedding. Load structures, including flame structures and clastic dikes, are locally present. Some beds grade laterally or vertically from sandstone to conglomerate, with many gravel lenses and channels occurring within sandstone beds. Conglomeratic deposits are typically well-stratified, although massive intervals are present. Coarser, predominantly cobble conglomerate intervals are mostly clast-supported, but many gravel lenses are supported by a sandy matrix. Meter-scale resistant paleosol horizons are darker gray/brown and contain extensive root casts. Conglomerate horizons within individual outcrops are as thick as 15 m (50 ft); total map unit thickness is at least 110 m (360 ft).

Anderson Ranch beds, informal—White to light gray, tabular to lenticular bedded, trough cross-bedded, fluvially reworked tephra deposits. Tephra is a mix of ash and pumice, often interbedded with silicic sand and gravel, and intrabasinal rip-up clasts. Rip-up clasts range from rounded pebbles to large angular fragments of finer-grained tephra and pumice (Thomas and Sears, 2020). Locally, conglomerate beds composed of almost entirely pumice pebbles are present. Zircon U-Pb dates from a reworked tuff interbedded with the Big Hole River member in this quadrangle gave a calculated weighted mean age of 9.3 ± 0.1 Ma (JM20HPR02, fig. 3A, table 1). Zircon U-Pb depositional dates from this unit in the adjacent Belmont Park Ranch quadrangle range from ca. 14.1 to 8.2 Ma (Brennan and others, 2024). Individual tephra beds are up to 30 m (100 ft) thick.

Tscs **Sweetwater member, informal (Miocene)**—Yellowish gray, light gray, and reddish gray, predominantly conglomerate with distinctly subangular to angular boulders as much as 2 m (6 ft) in diameter. Clasts lithologies reflect adjacent uplifted bedrock lithologies including an abundance of Paleozoic carbonate and siliciclastic clasts near the Snowcrest Range front, while basement clasts (gneiss and schist, often garnet-bearing) with lesser vesicular volcanic, pegmatite, and quartzite clasts are prevalent near the Greenhorn Range front. Localized beds of siltstone, limestone, and tuff are present in subordinate amounts. Clast sorting is generally poor. At outcrop scale, bedding can be indistinct or crudely stratified, and can show inverse grading (fig. 5). A tuffaceous interval sampled in this quadrangle gave a zircon U-Pb TuffZirc (Ludwig, 2012) age of 10.7 ± 0.4 Ma (DB23HPR02, fig. 3A). This unit in the adjacent Belmont Park Ranch quadrangle gave a ca. 12.5 Ma zircon U-Pb depositional date (Brennan and others, 2024). As thick as 150 m (492 ft) and thins westward, away from the range fronts where it interfingers with Tscu within the map area.

Tre **Renova Formation (Eocene to Miocene)**—Composed primarily of fine-grained rocks consisting of shale, mudstone, limestone, medium- or fine-grained sandstone beds, and localized conglomerates that largely reflect fluvial and lacustrine deposition. Estimated total thickness is at least 175 m (575 ft). Only shown in cross-section.

Kf **Frontier Formation (Cretaceous)**—Poorly exposed in quadrangle but in adjacent quadrangle to the east (Hadley, 1969) consists of dark-greenish gray, or brownish-gray, medium to very coarse-grained, lithic-rich sandstone. Generally, well bedded and commonly cross-bedded with heavily mineral (likely magnetite) laminations. Some lenses of subangular, polymictic pebble conglomerate. Tuffaceous or volcanic sandstone beds less than 1.5 m (approximately 5 ft) thick occur throughout the unit. Full thickness is not exposed in this quadrangle, but in the adjacent quadrangle (Hadley and others, 1980) it is as thick as 1,100 m (3,600 ft).

Kbl **Blackleaf Formation (Cretaceous)**—Medium gray, dark gray, and brown, siltstone, mudstone, and shale with minor thin interbeds of mostly medium-grained quartzose sandstone and rare volcaniclastic intervals. Lower contact is placed above the top of the Kootenai Formation gastropod limestone. Upper contact is poorly exposed within this map area. In most locations, the upper contact is thought to be generally gradational with the overlying Frontier Formation, but in the Snowcrest Range the upper contact is suggested to be a localized disconformity (Dyman and others, 1988). U-Pb detrital zircon (Rosenblume and others, 2021b; Gardner and others, 2022) and detrital apatite results (Finzel and others, 2025) were reported from samples (RRB-1 and RRB-65) collected in the eastern portion of this quadrangle (sec. 18). The detrital zircon results are interpreted to reflect eastern-derived far-traveled Appalachian sources for the base of this unit (RRB-1), transitioning up section to western-derived central Idaho sources with a ca. 104 Ma maximum depositional age and an overlapping apatite age-peak (sample RRB-65), likely reflecting relatively quick exhumation of first-cycle, igneous source terranes. Unit is likely correlative to the Thermopolis Shale in the adjacent Varney quadrangle (Hadley and others, 1980). Approximately 180 m (590 ft) thick.

Kk **Kootenai Formation (Cretaceous)**—White to gray to black siltstone and mudstone with intervals of subangular fine to coarse chert-lithic sandstone with irregular or lenticular bedding. Locally coarsens to chert-pebble conglomerate and pebbly sandstone in lenses and beds 0.3–7 m (1–23 ft) thick. Lower approximately 75 m (246 ft) of the unit is almost entirely siliciclastic. Upper approximately 20 m (66 ft) of the unit is gastropod limestone, a regional stratigraphic marker. See Rosenblume (2021a) for detrital zircon results (sample RRK-11, fig. 3) and a detailed measured section along the Ruby River, in the eastern portion of the map area (secs. 17, 18). Roseblume (2021a) reports a provenance dominantly sourced from recycled late Paleozoic to early Mesozoic strata from central Idaho and/or western Wyoming. Total thickness is approximately 95 m (312 ft; Hadley and others, 1980; Rosenblume, 2021a).

Jm **Morrison Formation (Jurassic)**— Recessive dark-greenish gray to reddish brown claystone and mudstone with poorly developed bedding. Contains sparsely distributed calcareous concretions, thin indurated beds of calcareous mudstone, and fine- to very fine-grained, orange-weathering sandstone. Estimated thickness is approximately 75 m (246 ft; Hadley and others, 1980). Underlying Jurassic Ellis Group rocks were not recognized within the map area.

Ŧru **Triassic Undivided**—Generally poorly exposed, mostly recessive, light gray to brownish gray interbedded limestone, silty limestone, fine-grained sandstone, siltstone and mudstone of the Thaynes, Woodside, and Dinwoody Formations; mapped as one unit. Total group thickness estimated to be 300–320 m (980–1,050 ft). Further southeast in the Snowcrest Range exposure is better and these individual units consist of:

Thaynes Formation—Interbedded sandstone, siltstone, and limestone. Yellow gray, very fine- to fine-grained calcareous sandstone is the predominant lithology. In places, sandstone grades into light gray sandy limestone with thin and irregular beds, locally dolomitic and contains chert nodules. Unit is approximately 15 m (50 ft) thick in the northern Snowcrest Range and thickens to approximately 140 m (450 ft) in the central part of the range (Lonn and others, 2000). Unit is not present in the Greenhorn Range to the north (Hadley, 1980).

Woodside Formation—Poorly exposed, interbedded reddish brown to reddish purple calcareous mudstone, siltstone, and subordinate very fine-grained sandstone in beds approximately 10–30 cm (0.3–1 ft) thick. Approximately 15–30 m (50–100 ft) thick within the map area, and thickens up to around 180 m (approximately 600 ft) near the central portion of the Snowcrest Range (Lonn and others, 2000).

Dinwoody Formation—Poorly exposed, interbedded silty shale, argillaceous and calcareous sandstone, and yellow-weathering platy to blocky dolomite or silty limestone. Locally fossiliferous, containing primarily fish bone fragments (Lonn and others, 2000). About 150 m (500 ft) thick.

Pp **Phosphoria Formation (Permian)**—Dolomite, chert, quartz sandstone, mudstone, and shale. Mostly exposed as irregularly bedded or massive chert 0.2–1.2 m (0.5–4 ft) thick. In the central and southern Snowcrest Range, recessive phosphatic mudstone intervals approximately 2 m (6.6 ft) thick are present that do not crop out in this quadrangle. Total unit thickness is approximately 130 m (420 ft).

IPq **Quadrant Formation (Pennsylvanian)**—Light gray to tan, medium to fine-grained, well-sorted quartz sandstone with variable carbonate and silicate cement. Locally contains tabular-planar cross-beds, less than 1 m (3.3 ft) in height. Notable pinkish-red reduction spots generally less than 1 cm (0.4 in) in diameter are locally abundant and likely reflect replacement of carbonate cement. Well- exposed, resistant ridge-forming unit within mapping area. Total unit thickness is approximately 180 m (590 ft).

IPMsr **Snowcrest Range Group (Late Mississippian to Pennsylvanian)**—Interbedded mudstone, siltstone, sandstone and limestone consisting of the Conover Ranch, Lombard, and Kibbey Formations; mapped as one unit. Folding and thrusting obscures the group stratigraphic thickness; the estimated total structural thickness is at least 330 m (1,080 ft) within this quadrangle based on mapped outcrop widths of the least deformed section, consistent with the 250–695 m (820–2,280 ft) thickness reported by Sheedlo (1984) in the northern Snowcrest Range.

Conover Ranch Formation—Heterogeneous unit consisting of reddish -brown to reddish purple mudstone with lesser thinly bedded limestone and calcareous sandstone and siltstone (Wardlaw and Pecora, 1985). Further south in the Snowcrest Range this unit is gradational into overlying Quadrant Formation (Lonn and others, 2000), but is poorly exposed and thin to absent in this quadrangle.

Lombard Formation—A lower unit of gray thin to thick indistinctly bedded limestone with thin interbeds of siltstone and shale. Exhibits textures ranging from micritic mudstone to wackestone and packstone, mostly with brachiopod, corals, and conodont fossils/fragments. Up to approximately 250 m (820 ft) thick (Sheedlo, 1984; Wardlaw and Pecora, 1985).

Kibbey Formation—Yellowish gray, thin-bedded, fine-grained sandstone with lesser micritic mudstone. Poorly exposed and generally forms slopes beneath the Lombard Formation. Approximately 75 m (250 ft) thick (Wardlaw and Pecora, 1985).

Mmc **Mission Canyon Formation (Mississippian)**—Light gray to brownish gray, medium to massive bedded, limestone and dolostone with textures varying from oolitic grainstone to fossiliferous packstone. Bioclasts include crinoids, bryozoans, brachiopods, corals, and their fragments. Locally contains nodules and lenses of yellowish brown to light olive-gray chert. Intervals of solution or collapse breccia are observed in the uppermost 30–60 m (98–197 ft) of the formation, and commonly considered to have been produced during erosion of the Mission Canyon Formation before deposition of the unconformably overlying Snowcrest Range Group (Hadley, 1969). Approximately 300–380 m (985–1,250 ft) thick.

Ml **Lodgepole Formation (Mississippian)**—Medium dark gray, medium gray weathering, fine to medium cyclically bedded, fossiliferous limestone and grayish red, thinly bedded calcareous shale. Fossils are predominately matrix supported with floatstone texture most common, containing 2 to 3 cm (0.8 to 1.2 in) rugose corals and fenestrate bryozoan larger than 5 cm (2 in), with lesser crinoid and brachiopod fragments. Approximately 190–240 m (625–790 ft) thick (Sheedlo, 1984).

MDtj **Three Forks and Jefferson Formation, undivided** (Devonian–Mississippian)—Interbedded shale, siltstone, sandstone, limestone, and dolostone. Where exposed, thickness estimates range from approximately 145–225 m (470–740 ft; Lonn and others, 2000). Only shown in cross-section. Devonian Maywood Formation and Ordovician Kinnikinic and Bighorn Formations were not recognized in this map area. Based on their limited presence to the south in the Snowcrest Range (Lonn and others, 2000) they were not shown in cross-section.

Ꞓrl **Red Lion Formation (Cambrian)**—Basal, recessive, red and green shale overlain by silty and fine sandy, medium gray dolomite. Upper contact is faulted in the quadrangle, but elsewhere in the Snowcrest Range is unconformably overlain by the Devonian Jefferson Formation. Approximately 30 m (98 ft) thick.

Ꞓpi **Pilgrim Formation (Cambrian)**—Pale yellowish gray dolomite. Lower interval contains many greenish shaley partings, and minor silty shale. Upper interval is mostly medium- to thick-bedded sandy dolomite containing lenses and thin beds of fine-grained white quartz arenite. Approximately 30–50 m (100–165 ft) thick.

Ꞓp **Park Formation (Cambrian)**—Green, fissile, recessive, non-calcareous shale. May contain poorly exposed, thin beds of limestone and intraformational limestone conglomerate (Hadley, 1969). Approximately 12–30 m (40–100 ft) thick.

Ꞓm **Meagher Formation (Cambrian)**—Light gray to yellowish brown, often mottled and locally weakly petroliferous, dolomite. Locally olive-gray limestone with thinly bedded, shaley partings. Approximately 110 m (360 ft) thick.

Ꞓw **Wolsey Formation (Cambrian)**—Green, fissile, recessive shale and sandy shale. Contains thin beds of glauconitic sandstone, grades upwards into the overlying Meagher Formation. Approximately 15–23 m (50–75 ft) thick based on mapped contacts.

Ꞓf **Flathead Formation (Cambrian)**—Orange, red, or white, mostly fine to coarse quartz arenite, but locally pebble conglomerate particularly near the base of the unit. Mostly medium-bedded, often cross-laminated with thin interbeds of fine-grained sandstone or greenish gray sandy shale. Unconformably overlies Archean–Paleoproterozoic basement rocks. As much as 30 m (98 ft) thick, grades upwards into overlying Wosley Formation.

Precambrian Metamorphic And Intrusive Rocks

XAm **Marble (Neoarchean and Paleoproterozoic)**—Medium gray to brown to white coarsely crystalline marble comprising calcite with lesser dolomite. Insubordinate amounts of quartz, diopside, and talc. Mapped marble bodies range from approximately 60–180 m (200–600 ft) thick.

XAa **Amphibolite (Neoarchean and Paleoproterozoic)**—Salt and pepper colored amphibolite comprising blocky amphibole with lesser secondary quartz hosted within the Dillon Gneiss. The main foliation is penetrative across lithologies. Amphibolite bodies are up to approximately 25 m (82 ft) thick.

Adg **Dillon Gneiss (Neoarchean)**—Light gray, tan to orange, strongly foliated, and commonly lineated quartzo-feldspathic gneiss with intercalated quartz, aplite, and pegmatic bodies. Mineralogy consists primarily of quartz, microcline, plagioclase, and minor biotite. Locally garnetiferous. Outcrops as resistant, thick, sheet-like masses commonly along foliation planes but in places is also massive. Hosts salt and pepper colored, foliated amphibolite bodies (XAa). Originally named the “Dillon Granite Gneiss” (Heinrich, 1960) and subsequently referred to as the Quartzofeldspathic Gneiss (James, 1990). Zircon U-Pb analysis yielded dates at ca. 2,715 and 2,670 Ma, which likely reflect the age of igneous emplacement (fig. 3C).

REFERENCES

Berg, R.B., 1979, Precambrian geology of the west part of the Greenhorn Range, Madison County, Montana: Montana Bureau of Mines and Geology Geologic Map 6, 16 p., 2 sheets, scale 1:28,160.
Brennan, D.T., Sears, J.W., and Mosolf, J.G., 2024, Geologic map of the Belmont Park Ranch 7.5′ quadrangle, Madison County, Montana: Montana Bureau of Mines and Geology Geologic Map 99, 1 sheet, scale 1:24,000, https://doi.org/10.59691/TJCH2055
Brennan, D.T., Parker, S.P., Mosolf, J.S., and Kylander-Clark, A., 2025, U-Pb geochronology data from rock samples collected in the Dillon, Polson and Wisdom 30′ x 60′ quadrangles, western Montana, 2023–2024: Montana Bureau of Mines and Geology Analytical Dataset 16.
Burfeind, W.J., 1967, A gravity investigation of the Tobacco Root Mountains, Jefferson Basin, Boulder Batholith, and adjacent areas of southwestern Montana: Bloomington, Indiana University, Ph.D. dissertation, 90 p.
Constenius, K.N., 1996, Late Paleogene extensional collapse of the Cordilleran foreland fold and thrust belt: Geological Society of America Bulletin, v. 108, p. 20–39.
Crawford, B.M. and Pearson, D.M., 2018, Geologic map of the Ashbough Canyon 7.5′ quadrangle, Beaverhead County, Montana: Montana Bureau of Mines and Geology EDMAP 12, 1 sheet, scale 1:24,000.
Dyman, T.S., Perry, W.J., and Nichols, D.J., 1988, Stratigraphy, petrology, and provenance of the Albian Blackleaf Formation and the Cenomanian to Turonian lower part of the Frontier Formation in parts of Beaverhead and Madison Counties, Montana: Mountain Geologist, v. 25, p. 113–128.
Finzel, E.S., Thomson, S.N., Pearson, D.M., Horkley, L., Garber, K., and Gardner, C., 2025, First cycle or polycycle? Combining apatite and zircon detrital U-Pb geochronology and geochemistry to assess sediment recycling and effects of weathering: Earth and Planetary Science Letters, v. 650, p. 119131, https://doi.org/10.1016/j.epsl.2024.119131
Gardner, C.T., Finzel, E.S., Rosenblume, J.A., and Pearson, D.M., 2022, Foreland basin response to middle Cretaceous thrust belt evolution, southwestern Montana, USA: Geosphere, no. 18, v. 6, p. 1783–1803. https://doi.org/10.1130/GES02521.1
Garson, Y.N., 1992, Cenozoic volcanism and extensional tectonics of the Timber Hill map area, southwestern Montana: Disruption of a Neogene paleovalley: Missoula, University of Montana, M.S. thesis, 51 p.
Hadley, J.B., 1969, Geologic map of the Varney quadrangle, Madison County, Montana: U.S. Geological Survey Geologic Quadrangle 814, 1 sheet, scale 1:24,000.
Hadley, J.B., Sandon, W.J., and Dutro, J.T., 1980, Geology of the Varney and Cameron Quadrangles, Madison County, Montana: U.S. Geological Survey Bulletin 1459, 110 p.
Heinrich, E.W., 1960, Geology of the Ruby Mountains and nearby areas in southwestern Montana, in Pre-Beltian geology of the Cherry Creek and Ruby Mountains areas, southwestern Montana: Montana Bureau of Mines and Geology Memoir 38, p. 31–62.
James, H.L., 1990, Precambrian geology and bedded iron deposits of the southwestern Ruby Range, Montana: U.S. Geological Survey Professional Paper, v. 1495, p. 1–39.
Le Bas, M.J., Le Maitre, R.W., Streckeisen, A., and Zanettin, B., 1986, A chemical classification of volcanic rocks using the total alkali silica diagram: Journal of Petrology, v. 27, p. 745–750.
Lonn, J.D., Skipp, B., Ruppel, E.T., Janecke, S.U., Perry Jr., W.J., Sears, J.W., Bartholomew, M.J., Stickney, M.C., Fritz, W.J., Hurlow, H.A., and Thomas, R.C., 2000, Geologic map of the Lima 30′ x 60′ quadrangle, southwest Montana: Montana Bureau of Mines and Geology Open-File Report 408, 42 p., 2 sheets, scale 1:100,000.
Ludwig, K.R., 2012, User’s manual for Isoplot Version 3.75–4.15: A geochronological toolkit for Microsoft Excel: Berkeley Geochronological Center, Special Publication 5.
Monroe, J.S., 1976, Vertebrate paleontology, stratigraphy, and sedimentation of the upper Ruby River basin, Madison County, Montana: Missoula, University of Montana, Ph.D. dissertation, 301 p., 12 plates, 1:24,000 scale.
Mosolf, J.G., and Kylander-Clark, A., 2023, U-Pb geochronology data from rock samples collected in the Dillon, Hamilton, Philipsburg, Townsend, and Wisdom 30′ x 60′ quadrangles, western Montana, 2020–2021: Montana Bureau of Mines and Geology Analytical Dataset 3.
Mosolf, J.G., and Sears, J., 2024, Geologic map of the Red Canyon 7.5′ quadrangle, Beaverhead and Madison counties, Montana: Montana Bureau of Mines and Geology Geologic Map 95, 1 sheet, scale 1:24,000.
Mosolf, J.G., Brennan, D.T., and Kylander-Clark, A., 2023, U-Pb geochronology data from rock samples collected in the Dillon, Ennis, Gardiner, Hamilton, Hebgen Lake, Lima, and Wisdom 30′ x 60′ quadrangles, western Montana, 2022–2023: Montana Bureau of Mines and Geology Analytical Dataset 5.
Mosolf, J.G., Brennan, D.T., Gavillot, Y., Parker, S., and Sears, J., 2023, Major oxide and trace element analyses of rock samples collected in the Dillon and Hamilton 30′ x 60′ quadrangles, southwest Montana: Montana Bureau of Mines and Geology Analytical Dataset 2.
Mosolf, J.G., and others, in process, Whole-rock geochemistry data from rock samples collected in the Dillon, Polson and Wisdom 30′ x 60′ quadrangles, western Montana, 2023–2024: Montana Bureau of Mines and Geology Analytical Dataset.
Parker, S.D., and Pearson, D.M., 2023, A kinematic model linking the Sevier and Laramide belts in the Idaho–Montana fold-thrust belt, U.S. Cordillera: Geosphere, v. 19, no. 6, 24 p.
Rosenblume, J.A., Finzel, E.S., and Pearson, D.M., 2021a, Early Cretaceous Provenance, sediment dispersal, and foreland basin development in southwestern Montana, North American Cordillera: Tectonics, v. 40, p. 1–31, https://doi.org/10.1029/2020tc006561
Rosenblume, J.A., Finzel, E.S., Pearson, D.M., and Gardner, C.T., 2021b, Middle Albian provenance, sediment dispersal, and foreland basin dynamics in southwestern Montana, North American Cordillera: Basin Research, p. 1–25, https://doi.org/10.1111/bre.12645
Ruppel, E.T., O'Neill, J.M., and Lopez, D.A., 1993, Geologic map of the Dillon 1° x 2° quadrangle, Idaho and Montana: U.S. Geological Survey Miscellaneous Investigations Series Map I-1803-H, scale 1:250,000.
Sheedlo, M.K., 1984, Structural geology of the Northern Snowcrest Range, Beaverhead and Madison Counties, Montana Western Michigan University, M.S. thesis, 132 p., 4 plates, scale 1:24,000.
Thomas, R.C., and Sears, J.W., 2020, Middle Miocene through Pliocene sedimentation and tectonics in Montana: A record of the outbreak and passage of the Yellowstone Hotspot, *in* Metesh, J.J., and Vuke, S., eds.: Montana Bureau of Mines and Geology Special Publication 122: Geology of Montana—Geologic History, v. 1, 25 p., available at http://www.mbmg.mtech.edu/pubs/GeologyofMontana/
Van Gosen, B.S., Berg, R.B., and Hammarstrom, J.M., 1998, Map showing areas with potential for talc deposits in the Gravelly, Greenhorn, and Ruby Ranges and the Henry’s Lake mountains of southwestern Montana: U.S. Geological Survey Open-File Report 98-224-B, scale 1:250,000.
Vuke, S.M., Porter, K.W., Lonn, J.D., and Lopez, D.A., 2007, Geologic map of Montana: Montana Bureau of Mines and Geology Geologic Map 62, 73 p., 2 sheets, scale 1:500,000.
Wardlaw, B.R., and Pecora, W.C., 1985, New Mississippian–Pennsylvanian stratigraphic units in southwest Montana and adjacent Idaho: U.S. Geological Survey Bulletin 1656-B, p. B1B9.

ACKNOWLEDGMENTS

Raymond Salazar, Stuart Parker, and Connie Thomson assisted with mineral separations at the MBMG Mineral Separation Laboratory. Andrew Kylander-Clark supported LA-ICPMS analysis and data reduction at the University of California, Santa Barbara. Ashley and Arron Steiner directed bulk-rock geochemical analyses at the Washington State University Peter Hooper Geoanalytical Laboratory.

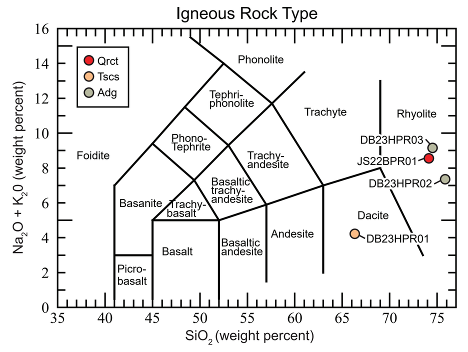


Figure 2. Whole-rock geochemical data from igneous and metaigneous rocks plotted using total alkali-silica classification diagram (after Le Bas and others, 1986). Sample points are color-coded to map unit. Plotted values are normalized to 100 percent. Data reported in Mosolf and others (2023, in process).

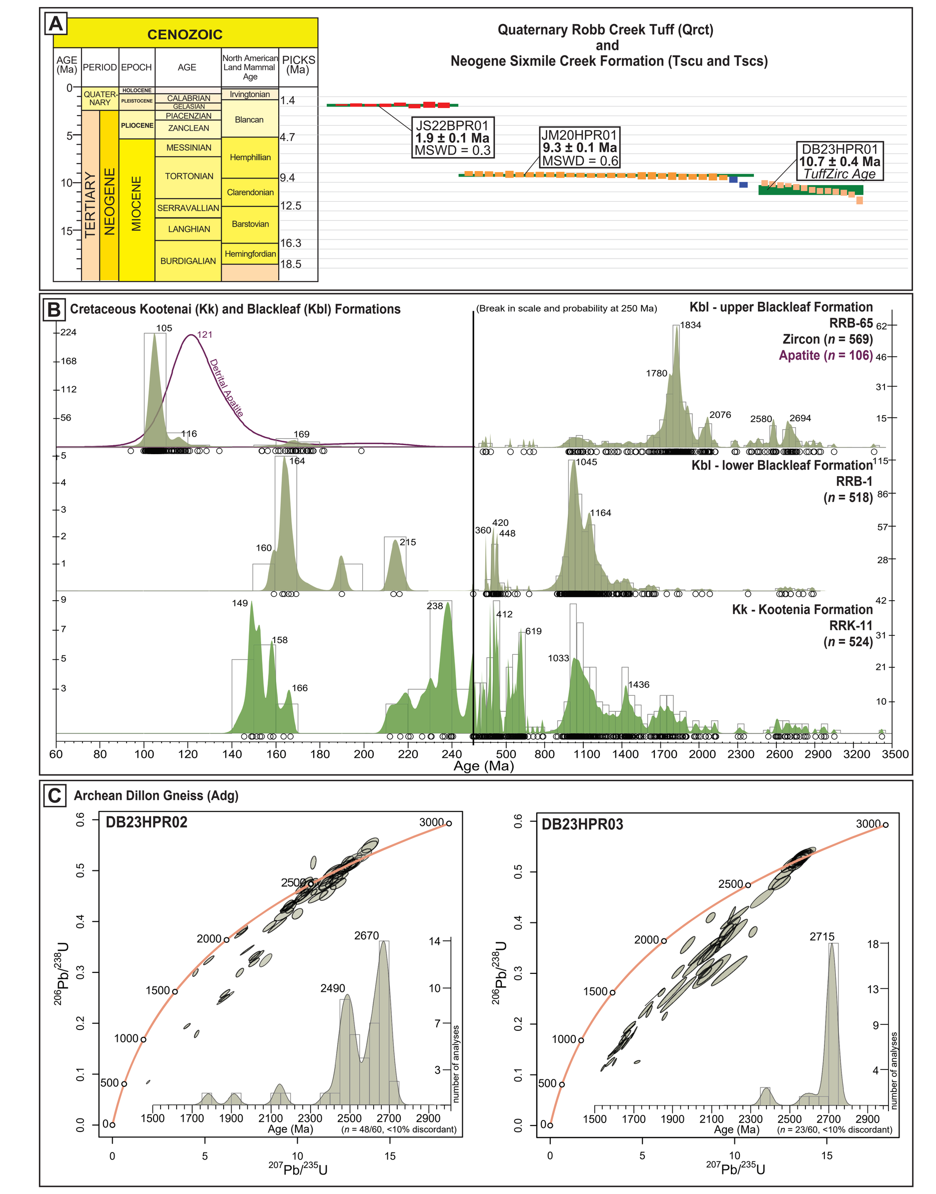


Figure 3. (A) Weighted mean (JS22BPR01, JM20HPR01) or TuffZirc (DB23HPR01; Ludwig, 2012) ages of youngest zircon populations, which are interpreted as volcanic and/or syndepositional from the Robb Creek tuff (Qrct, JS22BPR01) and Sixmile Creek Formation (Tscu, JM20HPR01 and Tscs, DB23HPR01). All data shown are ^{207}Pb corrected, ^{206}Pb/^{238}U dates that are <10% discordant. (B) Detrital zircon probability density plots from the Cretaceous Kootenai (RRK-11, Rosenblume and others, 2021a) and Blackleaf Formations (RRB-1, Rosenblume and others, 2021b; RRB-65, Gardner and others, 2022). Detrital apatite U-Pb probability density plot for sample RRB-65 is also shown in purple. The younger ~121 Ma age-peak likely reflects exhumation of the source rocks for the Blackleaf detritus (Finzel and others, 2025). (C) Wetherill Concordia plots and zircon kernel density estimate (KDE) plots (with 50 Myr bin and bandwidths) of U-Pb dates from the from the Archean Dillon Gneiss (map unit Adg), which are interpreted as metamorphic and/or igneous grains. KDE plots show <10% discordant ^{207}Pb/^{206}Pb dates. Major age-peaks, rounded to the nearest 5 Ma are labeled. The number of analyses that meet this filter and are plotted out of the total number of analyses is indicated (n = number of analyses plotted/total number of analyses). Complete geochronology data available from Brennan and others (2025); Mosolf and others (2023); Mosolf and Kylander-Clark (2023).

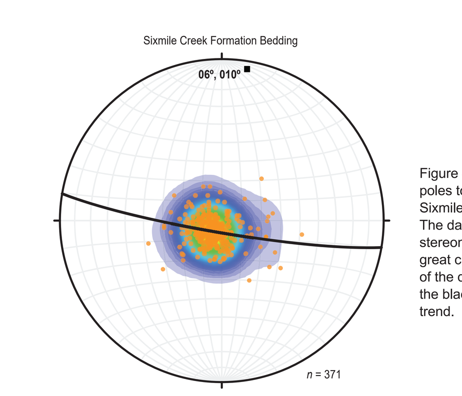


Figure 4. Lower-hemisphere projection of poles to bedding measurements from the Sixmile Creek Formation (Tscu and Tscs). The data are plotted on an equal-area stereonet and fit with a Kamb contour. The great circle represents the cylindrical best fit of the data, with the fold hinges marked by the black square labeled with plunge and trend.

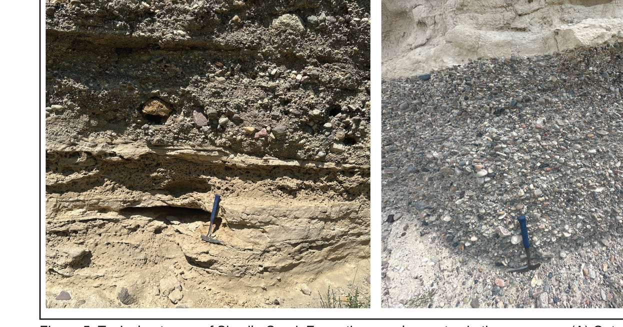


Figure 5. Typical outcrops of Sixmile Creek Formation conglomerates in the map area. (A) Outcrop photo showing a poorly sorted, angular cobble to boulder conglomerate, comprising basement, volcanic, and Paleozoic clasts. Crudely graded and reverse graded beds are interpreted to be locally sourced fanglomerate and debris flow deposits mapped as the Sweetwater Creek member (Tscs). (B) Outcrop photo showing a channel of well-imbricated, moderately sorted, sub- to well-rounded cobble to pebble conglomerate, consisting primarily of pink, tan, and gray quartzite clasts interpreted to reflect a distal provenance and mapped as the Big Hole River member included within the Sixmile Creek undivided map unit (Tscu).

MBMG
Montana Bureau of Mines and Geology

Geologic Map 109

Geologic Map of the Home Park Ranch 7.5′ Quadrangle, Southwestern Montana

Daniel T. Brennan

2025
https://doi.org/10.59691/MSIX7749