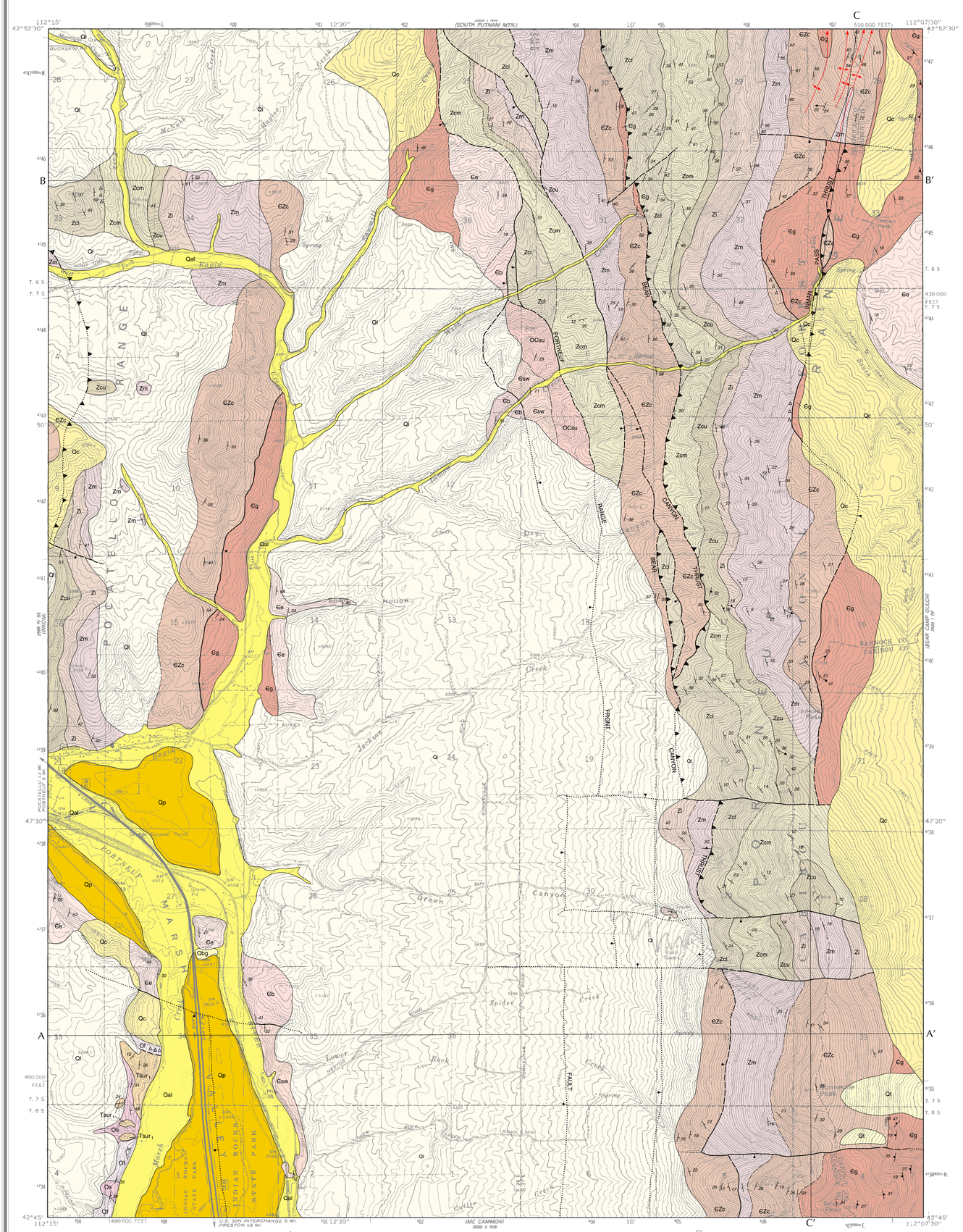
Geologic Map of the Bonneville Peak Quadrangle, Bannock and Caribou Counties, Idaho

James W. Riesterer, Paul Karl Link, and David W. Rodgers

2000



Base map from USGS digital raster graphic, 1968.

Control by USGS and USC&GS.

Topography by photogrammetric methods from aerial photographs taken 1969. Field checked 1971.

Projection: Idaho coordinate system, east zone (transverse Mercator). 1927 North American datum.

Datum is mean sea level.

UTM Grid and 1968 Magnetic North Declination at Center of Map

SCALE: 1:24,000

1 MILE, 1/2, 0

1 KILOMETER, 0.5, 0

Contour Interval 40 Feet

Dotted Lines Represent 20-Foot Contours

QUADRANGLE LOCATION

Geologic mapping was supported by the U.S. Geological Survey's EDMAP program and the Idaho State University Geology Department.

Digital cartography by Vita Taube, Diana Boyack, and Tim Funderburg at Idaho State University Geology Department's GIS Lab.

Layout by Jane S. Freed at the Idaho Geological Survey's Digital Mapping and GIS Lab.

CORRELATION OF MAP UNITS

Qal	Qc	Ql	Qt		Quaternary	CENOZOIC
Qbg						
Qp						
QTb				unconformity		
Tsur$_1$ (Starlight Formation)				Upper Miocene	Tertiary	
unconformity						
Of					Ordovician	PALEOZOIC
Os						
Og						
OCsu						
Gsw				Upper	Cambrian	
Gn						
Gb				Middle		
Ge						
Gg				Lower		
GZc						
unconformity						
Zm					Precambrian	LATE PROTEROZOIC
unconformity (Brigham Group)						
Zi						
Zcu						
unconformity						
Zcm						
Zcl						
Zpc						
Zb						
Zp						

DESCRIPTION OF MAP UNITS

Qal **Alluvium (Holocene)**—Unconsolidated mud, silt, sand, and gravel deposited in the flood plain of the Portneuf River and its major tributaries. Thickness is less than 30 m (100 feet).

Qt **Talus (Holocene and Pleistocene)**—Unconsolidated angular boulders deposited at the base of steep slopes, with little or no matrix material present. Forms immediately below source outcrops. Thickness is less than 10 m (30 feet).

Qc **Colluvium (Holocene and Pleistocene)**—Poorly consolidated angular to subangular clasts, ranging from boulders to pebbles, in a matrix of finer grained material. Thickness is unknown, probably less than 5 m (15 feet).

Ql **Loess (Holocene and Pleistocene)**—Unconsolidated wind-deposited silt that mantles topography in lowlands. Thickness is less than 20 m (70 feet).

Qbg **Bonneville Flood gravels (Pleistocene)**—Unconsolidated, well-rounded, cobbles and boulders deposited during the Bonneville Flood. Occurs locally downstream from basalt flows. Thickness is less than 10 m (30 feet).

Qp **Basalt of Portneuf Valley (Pleistocene)**—Dark gray, massive, commonly vesicular tholeiitic basalt. Occurs as a long, narrow deposit with a flat flow-top and steep, cliff-like eroded sides; deposited in the paleo-Portneuf River course. Scour marks, preserved locally on the surface, were formed during the Bonneville Flood. The Portneuf basalt yielded a whole-rock K-Ar date of 0.583 ± 0.104 Ma (Scott and others, 1982).

QTb **Basin fill and upper member of Starlight (Salt Lake) Formation (Pleistocene, Pliocene, and Miocene)**—Conglomeratic and tuffaceous materials. Includes upper member of Salt Lake (Starlight) Formation (Link and Stanford,1999; Rodgers and Othberg, 1999). Cross section only.

Starlight Formation

Tsur$_1$ **Inkom tuff member (upper Miocene)**—Crystal-vitric tuff with interbedded sandstone. Tuff is white to light gray, generally thinly bedded and thinly laminated, and locally massive. Crystals include very fine-grained plagioclase and hornblende. Local tuffaceous sand intervals are coarse grained and contain anhedral hornblende crystals as long as 3 mm. The tuff lies disconformably over the Swan Peak Quartzite and Fish Haven Dolomite in sec. 34, T. 7 S., R. 36 E., and sec. 3, T. 8 S., R. 36 E. The upper contact is not exposed in the map area.

Of **Fish Haven Dolomite (Ordovician)**—Medium gray to light gray, mottled, medium- to thick-bedded, bioclastic dolostone with sparry calcite- and dolomite-filled molds of bioclasts and fenestrae. The unit is only exposed in the southwest part of the map area. The upper contact is not exposed. The lower contact is placed at the first appearance of dolostone above the Swan Peak Quartzite. Thickness of the unit to the west of the Bonneville Peak quadrangle is approximately 260 m (830 feet; Trimble and Carr, 1976).

Os **Swan Peak Quartzite (Ordovician)**—White quartzite and minor yellow-orange conglomerate. Quartzite is white, orange-weathering, thickly bedded, planar-stratified, trough-crossbedded, well-sorted, fine- to coarse-grained quartz arenite. Graded beds on a scale of <1 cm are common, and burrows are present locally. Conglomerate is strongly lithified and clast-supported, containing cobble-size angular clasts of gray limestone and white quartzite as long as 0.3 m, as well as smaller, subrounded quartz and quartzite clasts. In the map area, the unit is only exposed in sec. 34, T. 7 S., R. 36 E., and sec. 3, T. 8 S., R. 36 E. The upper contact is placed below the first appearance of the Fish Haven Dolomite. The lower contact is not exposed in the map area. In the Pocatello and Michaud quadrangles to the west, the Swan Peak Quartzite is approximately 300 m (960 feet) thick (Trimble and Carr, 1976).

Og **Garden City Formation (Ordovician)**—Thin-bedded, light gray, fossiliferous limestone. The Garden City Formation is not exposed in the map area, but is inferred to be present below a loess cap in the southeastern part of the map. The formation is described in nearby areas by Trimble and Carr (1976) where it is approximately 365 m thick (1,170 feet). Cross section only.

St. Charles Formation

OCsu **Upper member (Ordovician and Upper Cambrian)**—Medium gray, planar cross-bedded, fossiliferous (trilobite, brachiopod, ostracode), burrowed (*Planolites*), grainstone and packstone with abundant tan dolomitic silt to fine-sand intervals containing limestone intraclasts. Oncolites and climbing ripples are locally present. Limestone is purplish red in places, thinly laminated (commonly wavy laminae), very fine-grained, and stylolitic. The upper contact is not exposed in the map area. The lower contact is placed at the first appearance of limestone above the underlying arenite. Trimble and Carr (1976) determined an approximate thickness of 60 m (190 feet) in nearby areas to the west, but the unit is at least 200 m (640 feet) thick in the Bonneville Peak quadrangle.

Gsw **Worm Creek Member (Upper Cambrian)**—Medium brown to dark brown and orange to gray, trough cross-bedded, medium- to thick-bedded, fine- to medium-grained, carbonate-cemented arkosic arenite. The unit is poorly exposed north of Inman Creek in the E½ sec. 1, T. 7 S., R. 36 E., and is inferred to be present below a loess cap in the southeastern part of the map area. The lower contact is not exposed in the map area. The thickness in nearby areas is between approximately 150 m and 400 m (480 feet and 1,280 feet; Trimble and Carr, 1976; Kellogg, 1990).

Gn **Nounan Dolomite (Cambrian)**—Light colored, poorly bedded recrystallized dolomite. Not exposed in the map area but is inferred to be present below a loess cap in the southwestern part of the map. The formation is described in nearby areas by Trimble (1976) where it is between 170 m and 230 m (540 feet and 740 feet) thick. Cross section only.

Gb **Bloomington Formation (Cambrian)**—Limestone, thinly bedded green shale, and carbonate mudstone. Exposed limestones include (1) dark gray, light gray weathering, coarse-grained packstone with abundant argillite rip-ups, possible burrows, and interbeds of light gray, tan to brown weathering siltstone; (2) medium gray, tan weathering, moderately to thickly bedded, commonly thinly laminated lime mudstone with abundant silty partings and wavy laminae. The lower part of the section is characterized by green, thinly laminated shale with abundant oblate, greenish gray limestone nodules. Neither the upper nor the lower contact is exposed in the map area. In nearby areas formation is approximately 550 m thick (1,660 feet; Trimble, 1976).

Ge **Elkhead Formation (Cambrian)**—Dark to medium gray, light gray weathering, silty, medium-bedded to massive limestone with common wavy laminae, silty partings, and ooids. Locally contains oncolites and shell fragments (brachiopods?). Ooids range in diameter from about 2 mm to 1 cm and are commonly concentrated in distinct layers, although isolated ooids may also be found. Micritic matrix is locally recrystallized to form a dark gray sparite. Contacts are not exposed in the map area. Trimble (1976) determined a thickness of approximately 650 m (2,080 feet) in nearby areas to the west.

BRIGHAM GROUP

Gg **Gibson Jack Formation (Cambrian)**—Thinly laminated, green-brown shale and argillite, medium bedded to massive, green-brown sandstone, and rare light gray limestone. Shale is thinly laminated, green to brown, rusty-orange weathering, and micaceous. Commonly strongly cleaved; forms small outcrops and talus. Sandstone is green-brown, fine-grained, well-sorted, thinly bedded to massive, moderately friable, micaceous, feldspathic arenite, commonly interbedded with green argillite and shale. Rare limestone is blue gray weathering, medium to dark gray, fresh, thickly bedded to massive, locally fossiliferous, silty oolitic wackestone and packstone with abundant silty partings. Forms abundant talus. Previous workers (e.g., Oriel and Armstrong, 1971; Trimble, 1976; Hefferan, 1986) have divided the formation into three informal members. Most of the formation seen in the Bonneville Peak area fits the description of either informal member A or C. Thick intervals of sandstone corresponding to member B were not observed and, as a result of this and generally poor exposures, member designations were not made. The upper contact is not exposed. The lower contact is placed at the base of the first green shale interval above the Camelback Mountain Quartzite. The Gibson Jack Formation is thickened by thrust faulting in the northern part the map area. The formation is at least 375 m thick and, in surrounding areas, as much as 750 m thick (1,200 feet and 2,400 feet; Kellogg, 1990).

GZc **Camelback Mountain Quartzite (Cambrian and Upper Proterozoic)**—Thickly bedded to massive, trough- and planar-crossbedded, white to pink, locally orange-stained, moderately well-sorted to poorly sorted, medium-grained to very coarse-grained quartz arenite with abundant Liesegang banding. The Camelback Mountain Quartzite tends to become finer grained and better sorted upsection. Coarse-grained quartz arenites in the middle to lower part of the unit contain abundant trough crossbeds, pebble lags, and graded beds. The basal part is characterized by moderately sorted, clast- and matrix-supported, quartz-pebble conglomerate with interbeds of purple arkosic arenite similar to the underlying Mutual Formation. Pebbles are rounded, mostly 1-2 cm long but as long as 4 cm, white quartz, white quartzite, and red chert. Purple quartzite interbedded with white conglomerate near the base of the unit make the lower contact difficult to identify in the field. South of the map area in Upper Rock Creek (McCammon 1:24,000 quadrangle), the conglomerate from the base of the Camelback Mountain Quartzite is incised into the underlying Mutual Formation (Link and others, 1987). Based on this, the lower contact of €Zcm in the Bonneville Peak map area is placed at the lowest occurrence of white cobble conglomerate above *Zm*. In the southern part of the map area the unit is 425 m (1,360 feet) thick, thinning to 250 m (790 feet) in the north.

Zm **Mutual Formation (Upper Proterozoic)**—Purple quartzite and conglomerate, maroon argillite, and rare white to pink quartzite. Dark to light purple, moderately well sorted, moderately to thickly bedded, abundantly trough cross-stratified, coarse-grained to granule, arkosic lithic arenite. Euhedral feldspars as long as 0.75 cm are locally abundant in the southeastern part of the map area, but may be absent, and appear to become more prevalent upsection. Thinly laminated, maroon, micaceous argillite forms a pervasive interval as thick as about 40 m (128 feet) near the base of the formation. Channels of pebble conglomerate, containing clasts of quartzite and argillite in a purple, feldspathic arenite matrix, occur locally. Rare white to pink, fine-grained to medium-grained quartz arenite crops out in association with the maroon argillite. The scoured basal contact of the Mutual Formation is defined at the top of the uppermost green argillite of the Inkom Formation. Thickness of the Mutual Formation varies. In the northern and southern parts of the map area, the formation is 650 m (2,210 feet) thick but thins to approximately 250 m (790 feet) in the central part.

Zi **Inkom Formation (Upper Proterozoic)**—Green siltstone interbedded with fine- to medium-grained, green-gray, fine sandstone and local channelized conglomerate. Thinly laminated, micaceous, green argillite, slate, and phyllite, forming abundant talus, are diagnostic of the formation. Sandstone is well-sorted, angular, green-gray, micaceous, fine- to medium-grained, arkosic arenite. The base of the formation is defined by the disappearance of the uppermost channels of green, poorly sorted, quartz and feldspar bearing, granule to pebble conglomerate of the upper member of the Caddy Canyon Quartzite. Thickness of the Inkom Formation is highly varied, and the formation is locally absent. In the northern part of the map area, the formation is as thick as 325 m (1,040 feet). The formation thins to the south and is absent in the central part of the map area. In the southern part of the map, the unit reappears and is as thick as 225 m (765 feet).

Caddy Canyon Quartzite

Zcu **Upper member (Upper Proterozoic)**—Green siltstone incised by channels of green granule to pebble conglomerate. Fine-grained intervals are identical to those included in the Inkom Formation. Conglomerate is moderately well-sorted, matrix supported, granule to pebble in size. Clasts are subrounded quartz and weathered feldspars as long as 1 cm; average is about 0.75 cm long. Matrix is predominantly green, moderately to poorly sorted, medium- to coarse-grained, arkosic arenite; locally it is green chloritic phyllite. The unconformable base of the member is placed between the base of the lowest siltstone and at the top of the uppermost purple quartzite with abundant gray argillite rip-ups above a scoured contact. Thickness of the unit ranges from 75 m to 175 m (240 feet to 560 feet).

Zcm **Middle member (Upper Proterozoic)**—Purple quartzite, gray argillite, and conglomerate. Quartzite is light purple, poorly sorted, thickly bedded to massive, coarse-grained, feldspathic and lithic arenite. Trough crossbeds, pebble lags, and isolated pebbles are common. Argillite intervals are moderately bedded, generally less than 1 m thick, thinly laminated, gray to purple, and micaceous. Conglomerate is poorly sorted and clast and matrix supported. Clasts consist of quartz, quartzite, argillite, and chert pebbles to cobbles. Quartz, quartzite, and chert clasts are rounded to subrounded, averaging about 1-2 cm but as long as 4 cm. Argillite rip-ups are angular, averaging about 5 cm long but as long as 1 m. Matrix is light purple, poorly sorted, angular to subrounded, coarse-grained to granular, chert-lithic arenite. The lower contact is placed at the top of the dark gray dolomite or recrystallized limestone that locally caps the lower member or, in the absence of carbonate, at the top of the thick interval of argillite that caps the white quartzite of the lower member. Thickness of the middle member is approximately 325 m (1,040 feet).

Zcl **Lower member (Upper Proterozoic)**—Tan, white, and pink quartzite and uppermost, locally present dolomite, dark gray recrystallized limestone, and gray argillite. Quartzite is white, tan, or pink, well-sorted, subrounded, thickly bedded, trough cross-stratified, medium-grained to fine-grained quartz arenite that weathers orange. The uppermost part of the lower member contains abundant, thinly laminated, brown to gray, locally orange- or red-weathering argillite or siltstone. Locally, the quartzite is capped by a thin (as much as 10 m) marker bed of dark gray, thickly bedded to massive, coarse-grained crystalline limestone and dolomite. The lower contact of the lower member is not exposed in the map area, but is defined in surrounding areas as the top of the uppermost siltstone of the Papoose Creek Formation (e.g., Trimble, 1976). Thickness is approximately 700 m (2,240 feet).

Zpc **Papoose Creek Formation (Upper Proterozoic)**—Thin-bedded, sandstone and siltite with characteristic soft-sediment deformation. Cross section only.

Zb **Blackrock Canyon Limestone (Upper Proterozoic)**—Dark gray, locally oolitic, thick-bedded limestone. Cross section only.

Zp **Pocatello Formation (Upper Proterozoic)**—Conglomerate, diamictite, sandstone, siltstone, laminated shale, mafic volcanic rocks, and thin, discontinuous beds of dolomite and limestone. Cross section only.

SYMBOLS

- Contact: Dashed where approximately located; dotted where concealed
- Fault: Dashed where approximately located; dotted where concealed; ball and bar on downthrown side
- Thrust fault: Dashed where approximately located; dotted where concealed; teeth on upper plate
- Anticline: Trace of axial plane showing direction of plunge axis
- Syncline: Trace of axial plane showing direction of plunge axis
- Strike and dip of bedding
- Strike and dip of foliation
- Strike and dip of bedding with trend and plunge of fault lineations
- Breccia

GEOLOGIC HISTORY

The Bonneville Peak quadrangle contains neo-Proterozoic (1,000-543 Ma) to Middle Cambrian siliciclastic and minor carbonate rocks of the Brigham Group, overlain by Cambrian and Ordovician carbonate and quartzite strata (Oriel, 1968; Oriel and Armstrong, 1971; Trimble, 1976; Trimble and Carr, 1976; Hefferan, 1986). The Bonneville Peak area has undergone three phases of deformation: Cretaceous shortening of the Idaho-Wyoming thrust belt, middle Miocene to Pliocene east-west extension, and overlapping north-south extension related to the formation of the Basin and Range and Snake River Plain provinces (Corbett, 1978; Oriel and Platt, 1980; Burgel and others, 1987; Kellogg, 1990; 1992; Rodgers and others, 1990; Pierce and Morgan, 1992; McQuarrie and Rodgers, 1998).

Brigham Group

The late neo-Proterozoic to Middle Cambrian Brigham Group contains "dominantly quartzitic strata above the Blackrock Canyon Limestone and below mappable Cambrian carbonates" (defined by Link and others, 1985, p. 101, following Crittenden and others, 1971). The strata were deposited in shallow marine and fluvial environments that belong to four stratigraphic sequences bounded by regional unconformities (Trimble, 1976; Christie-Blick and others, 1988; Link and others, 1987; Levy and others, 1994). These are likely 2nd-order sequences representing tens of millions of years of deposition.

The lowest strata exposed in the Bonneville Peak quadrangle are shallow-marine and braided-stream quartzite and siltite beds of the main body (lower and middle members) of the Caddy Canyon Quartzite. Sequence boundary 1, below the upper member of the Caddy Canyon Quartzite and overlying Inkom Formation, is overlain by several incised valleys filled with conglomerate and intraclastic breccia. These likely formed during 3rd-order eustatic sea-level fluctuations during the ~600 Ma Varanger (Vendian) glaciation (Levy and others, 1994). Sequence boundary 1 can be seen north of Green Canyon in sec. 29, T. 7 S., R. 37 E. There, coarse-grained braided stream deposits of the middle member Caddy Canyon Quartzite are abruptly overlain by offshore mudstone and submarine conglomerate-filled channels of the upper member.

Above sequence boundary 2, the braided fluvial Mutual Formation represents a regional period of lowered sea level. Sequence boundary 2 is best exposed just north of the town of Inkom in the NE¼ sec. 16, T. 7 S., R. 36 E. Although less accessible and less well-exposed, the dramatic nature of this erosional Type 1 sequence boundary can best be seen in the Sawmill Creek drainage in the SE¼ sec. 25, T. 7 S., R. 36 E. In this location, conglomerate-filled channels of the Mutual Formation are scoured into the underlying Inkom Formation.

Above sequence boundary 3, the shallow marine *Skolithos*- and *Cruziana*-bearing Camelback Mountain Quartzite (basal unit of the 1st order, 100-m.y. duration, Sauk sequence) records increased rates of continental margin subsidence that produced the Middle and Late Cambrian passive margin (Cordilleran miogeocline). Sequence boundary 3 is not seen as an erosional contact in the Bonneville Peak quadrangle, but just to the south, in Upper Rock Creek (McCammon quadrangle), it underlies erosional channels of Camelback Mountain Quartzite scoured into the underlying Mutual Formation. The northward change from a disconformable contact to an apparently conformable contact may be a result of more rapid subsidence to the north.

Cambrian and Ordovician Strata

Overlying the Brigham Group in the Bonneville Peak quadrangle and regionally in southeast Idaho is a sequence of Cambrian to Ordovician shallow marine carbonate and subordinate quartzite strata. The oldest of these units, the Elkhead Limestone, represents the beginning of a transition from primarily siliciclastic to primarily carbonate deposition along the Cordilleran margin (Oriel, 1968; Link and others, 1987).

Snake River Plain Volcanism

Beginning at approximately 10 Ma, extensive rhyolitic volcanism occurred in the eastern Snake River Plain (Pierce and Morgan, 1992). The informal Inkom tuff member of the upper member, Tertiary Starlight Formation, with an interpolated late Miocene age of 8.5 ± 0.5 Ma based on chemostratigraphic correlation (Rodgers and Othberg, 1999), lies disconformably on the Ordovician Fish Haven Limestone and Swan Peak Quartzite in the southwest quarter of the quadrangle.

Pleistocene Deposits

The basalt of Portneuf Valley, dated at 0.583 ± 0.104 Ma (Scott and others, 1982), was erupted from a vent in Gem Valley, east of the Portneuf Range. It flowed over 40 km down the path of the Portneuf River and is preserved along the Portneuf River and Marsh Creek in the western part of the Bonneville Peak quadrangle.

Deposits of loess containing well-developed soils, which overlie the basalt of Portneuf Valley in nearby areas, suggest an extended period of eolian-fluvial deposition following the end of volcanism (Scott and others, 1982). The Bonneville Flood, an outburst flood from the Bonneville Basin to the south at approximately 14-15 Ka (O'Connor, 1993), removed Pleistocene sediments from the valley bottom, scoured and polished the basalts, and deposited large boulders.

DEFORMATION

Mesozoic Deformation

Rocks in the Bonneville Peak quadrangle lie above and west of the Putnam thrust, a major structure in the Idaho-Wyoming salient of the Cretaceous Sevier thrust belt (Corbett, 1978; Burgel and others, 1987; Kellogg, 1990, 1992). Upper Paleozoic and Mesozoic rocks are absent within the Bonneville Peak quadrangle owing to the erosion of hanging-wall strata as a result of uplift along a footwall ramp of the Putnam thrust west of the quadrangle (Link and others, 1985; Rodgers and Janecke, 1992).

Within the Bonneville Peak quadrangle, top-to-the-east shortening was accommodated along the Bear Canyon thrust (Pogue, 1984; Kellogg, 1992) that places the Caddy Canyon Quartzite over the Camelback Mountain Quartzite. The thrust has been rotated to its present east dip above the west-dipping Portneuf Range-front fault system. The Ordovician Fish Haven Dolomite in the southern part of the Bonneville Peak quadrangle is exposed below a lateral ramp of the Bear Canyon thrust. This lateral structure trends east-southeast and is offset to the south by the Portneuf Range frontal normal fault. Its regional extent suggests it may be part of a through-going lateral shear in rocks of the Putnam thrust plate. A westward extension of this lateral structure may be the Portneuf Narrows tear fault, which is the southern termination of the Rapid Creek fold in the Pocatello Range in the Inkom quadrangle to the west (Burgel and others, 1987).

Additional shortening was accommodated along the Inman Pass thrust, exposed in the northeastern part of the quadrangle along cross sections B-B′ and C-C′. The northernmost exposed section of this fault places Camelback Mountain Quartzite over Gibson Jack Formation, whereas further to the south the fault is contained within Gibson Jack Formation and has resulted in significant thickening of the unit. Offset on this fault is small and most likely a minor splay of the Bear Canyon thrust. The fault passes northward into tight folds in the Camelback Mountain Quartzite. Near Inman Pass, Miocene extensional tectonism has reactivated this fault with a normal sense of motion, obscuring original thrust relations. Corbett (1978) and Hefferan (1986) mapped this area as a thrust klippe.

Basin and Range Deformation

Numerous large- and small-scale, north-striking normal faults seen in the Bonneville Peak quadrangle record a major phase of Basin and Range deformation that rotated Portneuf Range strata and the Bear Canyon thrust to their present east dip (Kellogg, 1992; Kellogg and others, 1999). The Portneuf Range frontal fault in the northeast part of the quadrangle places Cambrian and Ordovician carbonate and quartzite strata from the hanging wall of the Bear Canyon thrust on Caddy Canyon Quartzite in the footwall. Total offset on the Portneuf Range fault varies, with approximately 3.3 km offset in the northern quadrangle and 6.5 km in the south. This difference in offset is attributable to the numerous synthetic normal faults in the northern part of the quadrangle that accommodated some extension and are not present or have less offset in the southern part of the quadrangle.

Small-scale, east-striking normal faults, which cut the north-striking structures, exist throughout the Bonneville Peak quadrangle (Corbett, 1978). Some of these structures may have formed as tear faults in the Cretaceous (Kellogg, 1990) and were reactivated in latest Cenozoic time to accommodate downwarping along the margins of the eastern Snake River Plain to the north (McQuarrie and Rodgers, 1998). Offset on these faults varies, with a maximum observed offset of approximately 600 m in sec. 23, T. 6 S., R. 37 E. At this locality, rocks of the Gibson Jack Formation are placed on rocks of the Mutual Formation. Most other east-striking faults in the quadrangle have offsets of less than 100 m.

REFERENCES

Burgel, W.D., D.W. Rodgers, and P.K. Link, 1987, Mesozoic and Cenozoic structures of the Pocatello region, southeastern Idaho, *in* W.R. Miller, ed., The Thrust Belt Revisited: Wyoming Geological Association, 37th Annual Field Conference Guidebook, p. 91-100.

Christie-Blick, N., J.P. Grotzinger, and C.C. von der Borch, 1988, Sequence stratigraphy in Proterozoic successions: Geology, v. 16, p. 100-104.

Corbett, M.K., 1978, Geologic map of the northern Portneuf Range: U.S. Geological Survey Open-File Report 78-1018, scale 1:48,000.

Crittenden, M.D., Jr., F.E. Schaeffer, D.E. Trimble, and L.A. Woodward, 1971, Nomenclature and correlation of some upper Precambrian and basal Cambrian sequences in western Utah and southeastern Idaho: Geological Society of America Bulletin, v. 82, p. 581-602.

Hefferan, K., 1986, Geology of the Bonneville Peak quadrangle, Bannock and Caribou counties, Idaho: Bryn Mawr University M.S. thesis, 90 p.

Kellogg, K.S., 1990, Geologic map of the South Putnam Mountain quadrangle, Bannock and Caribou counties, Idaho: U.S. Geological Survey Geologic Quadrangle Map GQ-1655, scale 1:24,000.

Kellogg, K.S., 1992, Cretaceous thrusting and Neogene block rotation in the northern Portneuf Range region, southeastern Idaho, *in* P.K. Link, M.A. Kuntz, and L.B. Platt, eds., Regional Geology of Eastern Idaho and Western Wyoming: Geological Society of America Memoir 179, p. 95-114.

Kellogg, K.S., D.W. Rodgers, F.R. Hladky, M.A. Kiessling, and J.W. Riesterer, 1999, The Putnam thrust plate, Idaho–Dismemberment and tilting by Tertiary normal faults, *in* S.S. Hughes and G.D. Thackray, eds., Guidebook to the Geology of Eastern Idaho: Idaho Museum of Natural History, p. 97-114.

Levy, M.E., N. Christie-Blick, and P.K. Link, 1994, Neoproterozoic incised valleys of the eastern Great Basin, Utah and Idaho: Fluvial response to changes in depositional base level, *in* R.B. Dalrymple and B.A. Zaitlin, eds., Incised-Valley Systems: Origin and Sedimentary Sequences: SEPM Special Publication 51, p. 369-382.

Link, P.K., and L.R. Stanford, 1999, Geologic compilation map of the Pocatello 30 by 60 minute quadrangle, Idaho: Idaho Geological Survey Technical Report 99-2, scale 1:100,000.

Link, P.K., G.B. LeFebre, K.R. Pogue, and W.D. Burgel, 1985, Structural geology between the Putnam thrust and the Snake River Plain, southeastern Idaho, *in* G.J. Kerns and R.L. Kerns, Jr., eds., Orogenic Patterns and Stratigraphy of North-Central Utah and Southeastern Idaho: Utah Geological Association Publication 14, p. 97-119.

Link, P.K., S.T. Jansen, P. Halimdihardja, A. Lande, and P. Zahn, 1987, Stratigraphy of the Brigham Group (Late Proterozoic-Cambrian), Bannock, Portneuf, and Bear River Ranges, southeastern Idaho, *in* W.R. Miller, ed., The Thrust Belt Revisited: Wyoming Geological Association 37th Annual Field Conference Guidebook, p. 133-148.

McQuarrie, Nadine, and D.W. Rodgers, 1998, Subsidence of a volcanic basin by flexure and lower crustal flow: The eastern Snake River Plain, Idaho: Tectonics, v. 17, p. 203-220.

O'Connor, J.E., 1993, Hydrology, hydraulics, and geomorphology of the Bonneville Flood: Geological Society of America Special Paper 274, 83 p.

Oriel, S.S., 1968, Preliminary geologic map of the Bancroft quadrangle, Caribou and Bannock counties, Idaho: U.S. Geological Survey Miscellaneous Field Studies Map MF-299, scale 1:24,000.

Oriel, S.S., and F.C. Armstrong, 1971, Uppermost Precambrian and Lower Cambrian rocks in southeastern Idaho: U.S. Geological Survey Professional Paper 394, 59 p.

Oriel, S.S., and I.B. Platt, 1980, Geologic map of the Preston 1° x 2° quadrangle, Idaho and Wyoming: U.S. Geological Survey Miscellaneous Investigations Series Map I-1127, scale 1:250,000.

Pierce, K.L., and L.A. Morgan, 1992, The track of the Yellowstone hot spot: Volcanism, faulting and uplift, *in* P.K. Link, M.A. Kuntz, and L.B. Platt, eds., Regional Geology of Eastern Idaho and Western Wyoming: Geological Society of America Memoir 179, p. 1-54.

Pogue, K.R., 1984, Geology of the Mt. Putnam area, northern Portneuf Range, Bannock and Caribou counties, Idaho: Idaho State University M.S. thesis, 106 p.

Rodgers, D.W., and S.U. Janecke, 1992, Tertiary paleogeologic maps of the western Idaho-Wyoming-Montana thrust belt, *in* P.K. Link, M.A. Kuntz, and L.B. Platt, eds., Regional Geology of Eastern Idaho and Western Wyoming: Geological Society of America Memoir 179, p. 83-94.

Rodgers, D.W., and K.L. Othberg, 1999, Geologic map of the Pocatello South quadrangle, Idaho: Idaho Geological Survey Geologic Map 26, scale 1:24,000, 2 sheets.

Rodgers, D.W., W.R. Hackett, and H.T. Ore, 1990, Extension of the Yellowstone Plateau, eastern Snake River Plain, and Owyhee Plateau: Geology, v. 18, p. 1138-1141.

Scott, W.E., K.L. Pierce, J.P. Bradbury, and R.M. Forester, 1982, Revised Quaternary stratigraphy and chronology in the American Falls area, southeastern Idaho, *in* Bill Bonnichsen and R.M. Breckenridge, eds., Cenozoic Geology of Idaho: Idaho Bureau of Mines and Geology Bulletin 26, p. 581-595.

Trimble, D.E., 1976, Geology of the Michaud and Pocatello quadrangles, Bannock and Power counties, Idaho: U.S. Geological Survey Bulletin 1400, 88 p.

Trimble, D.E., and W.J. Carr, 1976, Geology of the Rockland and Arbon quadrangles, Power County, Idaho: U.S. Geological Survey Bulletin 1399, 115 p.

Published and sold by the Idaho Geological Survey
University of Idaho, Moscow, Idaho 83844-3014