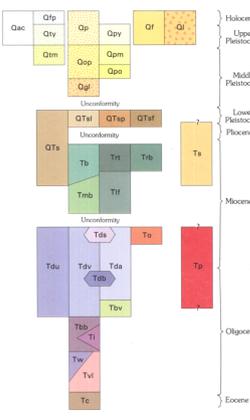


CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

- [Symbol] Flood-plain alluvium (Holocene)—Light brown to light gray, medium to coarse-grained sand and pebbly to bouldery gravel. Accumulates in low-lying areas adjacent to the main channel of the river. Thicknesses are less than 5 m.
- [Symbol] Undivided alluvium and colluvium (Holocene and upper Pleistocene)—Light brown and light gray sand, silt, and subordinate gravel deposited by flood waters and debris flows. Includes colluvium, sheetwash talus, and in local depressions. Locally includes colluvium, sheetwash talus, and alluvial fan deposits. Maximum thickness about 20 m.
- [Symbol] Undivided piedmont-slope alluvium (Holocene and upper Pleistocene)—Light brown to light reddish brown, poorly to moderately sorted silt, sand, and gravel that underlie broad piedmont-slope surfaces. These piedmont-slope surfaces, which are well developed in several parts of the map area, are underlain mostly by well-sorted alluvial fans and pediments. Includes alluvium of small streams and, in places, colluvium, alluvial slope wash, and talus. Thickness locally exceeds 30 m.
- [Symbol] Undivided alluvial-fan and talus deposits (Holocene and upper Pleistocene)—Heterogeneous mixture of sand, silt, and subordinate gravel deposited at bases of escarpments. Deposits are probably early Holocene and late Pleistocene where mapped in the northwestern part of map area and were mainly deposited at or near the end of Pleistocene glaciation. Maximum thickness in fans is about 10 m and along channels is less than 4 m.
- [Symbol] Landslide debris (Holocene and upper Pleistocene)—Mostly angular, poorly sorted debris moved by gravity from nearby areas of bedrock. Includes talus and colluvium. Maximum thickness about 30 m.
- [Symbol] Young terrace alluvium (upper Pleistocene)—Light brown to light reddish brown, medium to coarse-grained sand and pebbly to bouldery gravel. Mantled broad, slightly elevated river terraces that represent former, coarser flood plains of Beaver River. Capped by soil that contains a weak argillic B horizon and either is nonconformable or has a weak stage III C horizon and either is nonconformable or has a weak stage III C horizon. Mainly glacial outwash and associated alluvium of most recent glacial advance, the Pindeale, which ended about 12,000 to 15,000 years ago. Mapped only along Beaver River in northwestern part of map area. Thicknesses at least 4 m.
- [Symbol] Middle terrace alluvium (middle Pleistocene)—Light gray to light reddish brown, medium to coarse-grained sand and gravel. Forms river terraces 12-15 m above Beaver River in northwestern part of map area. Capped by soil that contains a moderately developed argillic B horizon and stage III C horizon. Mainly glacial outwash and associated alluvium of the late Pleistocene. Mapped only in northwestern part of map area. Maximum thickness about 4 m.
- [Symbol] Undivided older piedmont-slope alluvium (middle Pleistocene)—Poorly sorted, unconsolidated to poorly consolidated, silt sand and gravel composed of remnants of middle and old piedmont-slope alluvium (Qm and Qop, respectively). Deposits form at many localities that today compose terraces. All deposits are dissected by present streams. Maximum thickness 10-15 m.
- [Symbol] Youngest terrace alluvium (upper Pleistocene)—Light brown to light reddish brown, poorly to moderately sorted silt, sand, and gravel. Inter-tongues with or overlies middle terrace alluvium (Qm). Capped by soil that contains a weak argillic B horizon and stage II C horizon. Surface smooth and relatively undisturbed. Mapped only in Beaver basin area and most members were originally dated by Anderson and Rowley (1977). K-Ar ages in northwestern part of map area. Maximum thickness about 10 m.
- [Symbol] Middle piedmont-slope alluvium (middle Pleistocene)—Light brown to light reddish brown, poorly to moderately sorted silt, sand, and gravel. Inter-tongues with or overlies middle terrace alluvium (Qm). Capped by soil that contains moderately developed argillic B horizon and stage III C horizon. Surface highly dissected, young (Qm) and middle (Qop) piedmont-slope alluvium were deposited in channels cut on the surface of this unit. Mapped only in northwestern part of map area. Maximum thickness about 4 m.
- [Symbol] Gravel of Last Chance Bench (middle Pleistocene)—Light to reddish brown pebbly sand to sandy gravel on remnants of a widespread pediment cut on all faces of basin fill deposits (Qta). Unit named for a major scarp just north of Beaver (Machette, 1985). Capped by soil that has a very well developed, reddish brown argillic B horizon and a well developed stage III to well developed K horizon (see Cole and others, 1965, for definition of K horizon). Age of about 500,000 years is based on uranium trend determinations and on soil development (Machette, 1985). The gravel lies on a widespread pediment developed when stream drainage from Beaver basin was integrated with Escalante Desert about 15 km west of map area (Machette, 1985). Gravel extensively defined by beds which were most recently active during the late Pleistocene. Maximum thickness about 5 m.
- [Symbol] Undivided sedimentary basin-fill deposits of Beaver basin (lower Pleistocene to upper Pleistocene)—Includes six informal units composed of poorly to moderately consolidated fluvial and lacustrine deposits that comprise two major sedimentary sequences in the Beaver basin (Machette and others, 1984; Machette, 1985). Only the three units from the upper sequence are mapped separately here; they are exposed in the northwestern part of map area. Upper sequence consists of a gradational succession of lacustrine (Qta), piedmont (Qtp), and fan/marginal (Qtf) basin-fill sediments deposited in a closed basin occupied by Lake Beaver, a former shallow general lake (Machette, 1985); sequence is earthy to bluish-tan to light gray. Lower sequence consists of moderately to well-sorted, indurated (in surface exposure), calcareous, indurated, fine-grained deposits and a medial conglomerate (see Machette, 1985). The lower sequence may be correlative with upper part of Sevier River Formation (Qs). The lower sequence was deposited during more saline (arid?) conditions than the upper sequence, as evidenced by the presence of gypsum and calcium carbonate. Where undivided basin fill deposits of Beaver basin are mapped, they are poorly exposed but generally consist of the upper sequence. Deposition of basin fill deposits occurred concurrently with structural development of Beaver basin from at least 9 Ma (range-summit uplift sometime between 1.1 and 0.5 Ma) and stream drainage from the basin was integrated with the Escalante Desert (Sevier and others, 1982; Machette, 1985).
- [Symbol] Lacustrine facies (lower Pleistocene to upper Pleistocene)—Light to medium green silt clay and silt interbedded with well bedded, light gray to light brown, fine sand grading later into pebbly sand. Erodes to light reddish brown (where oxidized) sequence of interbedded rounded fluvial channel and debris (C) sand, light gray and light brown, subangular to subrounded, pebble to cobble gravel, and minor mudflow breccia that are all derived from and that contain toward the mountains. Generally erodes to low hills. Gravel contains zones of abundant manganese cementation. Contacts with lacustrine facies (Qta) and fan/marginal facies (Qtf) are poorly exposed, gradational, and intertonguing and thus are approximately level. Minimum exposed thickness 100 m; base covered by lacustrine facies (Qta) to upper Pleistocene (Qtp). Reddish brown to light reddish brown, sand, silt, and subordinate pebbly to cobble gravel and pebbly coarse-grained sandstone along the western front of the Tushar Mountains and the northern part of the Black Mountains. Generally erodes to moderately sloping, rounded hills. Base covered; thickness at least 200 m.
- [Symbol] Sevier River Formation (Pliocene and Miocene)—Shown only on cross section B-B' in southern part of map area. Sandstone, conglomerate, and siltstone, mostly of fluvial origin. Generally equivalent to undivided sedimentary basin fill deposits of Beaver basin (Qta), but found in areas drained by the Sevier River and its tributaries in the High Plateau province (index map; see discussion of drainage history by Anderson, 1987). May include deposits of Pleistocene age.
- [Symbol] Basaltic lava flows (Miocene)—Dark gray to black, resistant, locally vesicular or amygdaloidal, but most commonly dense, lava flows of olivine basalt or olivine-bearing mafic rock. Phenocrysts are generally anhedral olivine (altered in whole or in part to iddingsite), augite, and plagioclase in a glassy to aphanitic groundmass. One lava flow near the western edge of map area has a K-Ar (potassium-argon) age of 6.4 to 6.3 Ma, and another just west of map area has a K-Ar age of 7.6 to 0.3 Ma (Best and others, 1980). Maximum thickness about 20 m.
- [Symbol] Rhyolite of Tredy Valley (Miocene)—Moderately resistant, light gray, black, and pink, conspicuously flow-banded, locally vesicular, alkalic rhyolite lava flows forming a small volcanic dome in west-central part of map area. Lacks phenocrysts, and thus consists entirely of glass that is largely devitrified; obsidian "spathe tears" are abundant, however. A K-Ar age of 7.9 to 0.5 Ma was determined by H.H. Mehnert on "spathe tears"; analytical data are given in the table and sample locality is shown on map. Similar in age and structural setting to the following nearby small rhyolite masses: (1) 7.6 to 0.4 Ma rhyolite of Blue Ribbon Summit (Mehner and others, 1978; Rowley and others, 1978; age corrected for new decay constants of Steiger and Jäger, 1977), located in the adjacent quadrangle about 9 km west of rhyolite of Tredy Valley; (2) 7.5 to 0.25 Ma rhyolite south of Maverick Reservoir (Stevens and Stearn, 1982; T.A. Stevens, written comm., 1984), located in the adjacent quadrangle about 12 km northwest of rhyolite of Tredy Valley; and (3) rhyolite of Beaver Basin (Teb), located 6 km northeast of rhyolite of Tredy Valley and discussed below.
- [Symbol] Rhyolite of Beaver Airport (Miocene)—Resistant, light gray, black, and light pinkish-purple, conspicuously flow-banded, locally vesicular and locally amygdaloidal, alkalic rhyolite lava flows and basal and autoclastic flow breccia forming a small volcanic dome about 4 km south of Beaver airport in the northwestern part of map area. Lacks phenocrysts, and thus consists entirely of glass, which is largely devitrified and locally pectin; obsidian "spathe tears" are abundant, however. Dome is cut by a 1- to 2-m-wide dike of olivine basalt; olivine phenocrysts in the basalt are largely weathered to iddingsite. A K-Ar age of 8.3 to 0.3 Ma was determined by H.H. Mehnert on "spathe tears"; analytical data are given in the table and the sample locality is shown on map. Dome is part of a string of alkalic rhyolite bodies that fall along the east-trending Blue Ribbon Insetment of Utah and Nevada (Mehner and others, 1978; Rowley and others, 1978; these rhyolite bodies are generally younger from west to east (Rowley and others, 1981). Rhyolite bodies of an age similar to that of the map unit surround Beaver basin (Evans and Stearn, 1982). Thickness of dome about 35 m.
- [Symbol] Malic lava flows of Birch Creek Mountain (Miocene)—Moderately resistant, dark gray to black, vesicular to dense lava flows of olivine basalt(?) or olivine-bearing mafic rock. Phenocrysts are generally anhedral olivine (altered in whole or in part to iddingsite), augite, and plagioclase (labradorite) generally less than 1 mm long. Groundmass is largely devitrified glass containing microlites of plagioclase, augite, and Fe-Ti titanite oxides. Wickstrom (1982) suggested that the rock is probably a trachybasalt of the potassic-alkaline series according to the classification of Irvine and Bassey (1971). Correlates with potassic-alkaline mafic lava flows mapped by Anderson and others (1980, 1981), Cunningham and others (1983), and Machette and others (1984) in the southern Tushar Mountains; these rocks are considered to mark the start of extensional tectonism in southwestern Utah. Samples from nearby areas have yielded K-Ar ages of 23.2 to 1.0 Ma (Best and others, 1980) and 22.9 to 0.4, 22.8 to 0.4, and 22.4 to 0.1 Ma (older basaltic of Fleck and others, 1975; age corrected for new decay constants of Steiger and Jäger, 1977). Thickness typically 40 m; maximum thickness about 150 m.
- [Symbol] Tuff of Lion Flat (Miocene)—Poorly consolidated, pink, tan, gray, and yellow, undulating to moderately well bedded, crystal poor ash flow tuff and minor airfall and water laid tuff of alkalic rhyolite composition. Consists of about 10 percent phenocrysts of sanidine, subordinate plagioclase, and minor biotite. Fe-Ti oxides, and augite in a groundmass of devitrified shards. Also contains 1-4 percent lithic clasts, including those of rhyolite (Ttr). Named and mapped by Langhin (1980). Anderson and others (1981), and Machette and others (1984) in the area east of Beaver, just north of map area, described by Wickstrom (1982). Stevens and others (1984) suggested that the caldera source may underlie its outcrop area east of Beaver. Age is closely constrained between underlying 23 Ma Ostris Tuff and overlying formation of Louisa (Jim Sigward, written comm., 1984), which is about 22 Ma ("Dy" Hollow Formation" in Fleck and others, 1975, a term abandoned by Stevens and others, 1979; age corrected for new decay constants of Steiger and Jäger, 1977). Exposed only east of Tredy Valley, in the central part of map area, where the thickness is as much as 60 m.
- [Symbol] Ostris Tuff (Miocene)—Large formation, reddish brown to pinkish or pebbly gray, densely welded, crystal poor ash flow tuff. Typically contains about 20 percent phenocrysts of plagioclase, subordinate sanidine, and minor biotite, augite, and Fe-Ti oxides in a groundmass of devitrified glass shards. In many places has the texture and appearance of unglauconitic andesite. In most places includes a brownish-black basal vitrophyte 1-5 m thick. Commonly contains panicle-shaped tuff lentils, and in some places the upper part is a light gray to cream, vesicular upper vitrophyte. Secondary flowage and brecciation features are common in upper part. Consists of two cooling units in the extreme northern part of map area, but elsewhere only one is present. Ostris Tuff intertongues with the upper member of Mount Dutton Formation. Source area of Ostris Tuff is Moore Peak caldera (Cunningham and others, 1983; Stevens and others, 1984; Rowley, Williams, and Kaplan, 1986a,b; Rowley, Cunningham, and others, 1988a,b). In northern Sevier Plateau, 32 km northeast of map area, Ostris Tuff was informally named by Williams and Hademan (1971) and defined by Anderson and Rowley (1975). Earlier mapped by Callaghan and Parker (1961) and Willard and Callaghan (1962) in Sevier Plateau and other areas to the west and north as quartzite like member of Dry Hollow Formation, a term abandoned by Stevens and others (1979). Tuff of Beaver River and tuff of Black Mountain, two informal units formerly considered to be local ash flow breccias originating from local calderas in the north of map area (Langhin, 1980; Anderson and others, 1981; Machette and others, 1984), have been shown by detailed petrology to be separate cooling units of Ostris Tuff (Langhin and Anderson, 1987). K-Ar age is about 23 Ma (Fleck and others, 1975; age corrected for new decay constants of Steiger and Jäger, 1977). One dated sample, with an age of 22.7 to 0.4 Ma, was collected from the east of Nevershine Hollow, in the north-central part of map area. Maximum thickness about 30 m, locally pinched out against pre-eruptive topography.
- [Symbol] Mount Dutton Formation (Miocene and Oligocene)—Volcanic rock of intermediate (andesite to dacite) composition, together with local interbedded accumulations of felsic volcanic rock and tuffaceous sandstone. In accordance with the concepts of Parsons (1965, 1969) and Swadlow (1971) and in accordance with the concepts of Prosser (1973), most of the volcanic rocks (Tm) and of a more distal alluvial facies (Tta), both products of a series of stratovolcanoes oriented generally parallel to the present-day axis of the southernmost Tushar Mountains (Rowley and others, 1978; Anderson, 1980; Anderson, Rowley, and Blackman, 1986). Vent facies rocks consist mostly of lava flows and autoclasic flow breccia together with volcanic mudflow breccia in beds containing primary dikes indicating that they were deposited on the flanks of volcanoes. Rocks of this facies grade outward into weak argillic B horizon and stage II C horizon, which consist of a broad array of mostly volcanic mudflow breccia. The formation, its facies, and most members were originally dated by Anderson and Rowley (1977). K-Ar ages of 27-21 Ma were determined by Fleck and others (1975); ages corrected for new decay constants of Steiger and Jäger, 1977) in the distal to the base of a conspicuous, massive, resistant limestone bed, below which rocks are mostly red and above which they are mostly white. No such stratigraphic marker is present within the map area. The absence of this, or any other, established means of defining the two members has precluded mapping them separately here, although about two-thirds of the unit is "red" and the remainder "white." The overall sequence in map area nevertheless is lithologically similar to that south of map area, where the marker bed is present. Upper part consists of mostly soft, light gray to tan, friable, earthy and lacustrine breccia, and lower part consists of moderately resistant, mostly red, intertonguing argillaceous sandstone. Bedding is more uniform than that in lower part, which consists of soft to moderately resistant, mostly red, intertonguing argillaceous sandstone and calcareous fluvial siltstone, sandstone, and conglomerate. Conglomerate is the major rock type near base of normal part of accumulation at rates much slower than pedogenic amalgamation. Considered correlative to strata in southern Markagunt Plateau that Gregory (1949, 1950, 1951) assigned to Washwater Formation; Spieker (1964), however, demonstrated that type Washwater of northern Utah and adjacent parts of Wyoming does not extend east as far as Utah, but rather, he alone to the southern part of the state. Anderson and Rowley (1977), following the suggestion of Mackin (1960), discontinued use of the term "Washwater" in the southern High Plateaus and resurrected the name "Claron," which was first applied by Keith and Harder (1960) to strata equivalent to the Washwater in Iron Springs district of southwestern Utah. The age has not been established with certainty. Gregory (1950) reported "Cretaceous" basaltic flows (upper Washwater) near the eastern edge of map area (Fleck and others, 1975), age corrected for new decay constants of Steiger and Jäger, 1977). This sample (No. R-24) was accurately reported by Fleck and others (1975) as Ostris Tuff. Partial section at least 500 m thick exposed in the northwestern part of map area; thinning of the section is toward the south and west.
- [Symbol] Aluvial facies (Miocene and Oligocene)—Soft to moderately resistant, mostly light to dark gray and brown volcanic mudflow breccia and subordinate conglomerate and sandstone, lava flows, autoclasic flow breccia, and felsic airfall and water laid tuff. The predominant lithology as defined is characterized by subangular to angular pebbles to boulder-size clasts of volcanic rock that are petrologically identical to rocks of the vent facies and that occur in a muddy matrix most commonly unsupported by direct contact between clasts. Ratio of clasts to matrix varies greatly in different mudflows, but is generally less than in mudflows of the vent facies. Thickness of mudflows ranges from one meter to several tens of meters. Clasts in individual mudflows may be monolithic or polyblastic. Conglomerate is largely of fluvial origin, and in places is void green; contains less than 5 percent phenocrysts of plagioclase, sanidine, biotite, hornblende, quartz, and Fe-Ti oxides and about 1 percent lithic fragments of typical flow rock of the member. K-Ar age determinations on lava flows of 26.2 to 0.5 and 25.0 to 0.8 Ma were made by Fleck and others (1975); ages corrected for new decay constants of Steiger and Jäger, 1977) from samples collected from localities shown in map area. Thickness ranges from less than 10 m to more than 200 m, and increases with distance from source vents, which probably were near Blue Valley.
- [Symbol] Phonitic rock (Miocene or Oligocene)—Light gray, syndesmitic porphyry or monzonite porphyry consisting of generally finely crystalline, subhedral to subangular phenocrysts of plagioclase, hornblende, and magnetite in a holocrystalline, finely equigranular groundmass made up largely of orthoclase. Exposed only in one small outcrop in the mountains west of Lower Beaver Valley, where it gives the impression of being a large dike that discordantly cuts strata of Claron Formation (Anderson, 1965). However, this probably is a cupola extending from a larger (unroofed?) area about 5 km in diameter, dip away from a center not far from the outcrop; a radial fracture pattern over this center and overlying strata from the outcrop, a radial fracture pattern over this center and overlying strata from the outcrop, and a radial fracture pattern over this center and overlying strata from the outcrop, and a radial fracture pattern over this center and overlying strata from the outcrop. Age of the intrusion is probably Miocene; it domes and that post-dates the Buckskin Breccia, but its age with respect to younger units is unclear.

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Ostris Tuff (Miocene)—Large formation, reddish brown to pinkish or pebbly gray, densely welded, crystal poor ash flow tuff. Typically contains about 20 percent phenocrysts of plagioclase, subordinate sanidine, and minor biotite, augite, and Fe-Ti oxides in a groundmass of devitrified glass shards. In many places has the texture and appearance of unglauconitic andesite. In most places includes a brownish-black basal vitrophyte 1-5 m thick. Commonly contains panicle-shaped tuff lentils, and in some places the upper part is a light gray to cream, vesicular upper vitrophyte. Secondary flowage and brecciation features are common in upper part. Consists of two cooling units in the extreme northern part of map area, but elsewhere only one is present. Ostris Tuff intertongues with the upper member of Mount Dutton Formation. Source area of Ostris Tuff is Moore Peak caldera (Cunningham and others, 1983; Stevens and others, 1984; Rowley, Williams, and Kaplan, 1986a,b; Rowley, Cunningham, and others, 1988a,b). In northern Sevier Plateau, 32 km northeast of map area, Ostris Tuff was informally named by Williams and Hademan (1971) and defined by Anderson and Rowley (1975). Earlier mapped by Callaghan and Parker (1961) and Willard and Callaghan (1962) in Sevier Plateau and other areas to the west and north as quartzite like member of Dry Hollow Formation, a term abandoned by Stevens and others (1979). Tuff of Beaver River and tuff of Black Mountain, two informal units formerly considered to be local ash flow breccias originating from local calderas in the north of map area (Langhin, 1980; Anderson and others, 1981; Machette and others, 1984), have been shown by detailed petrology to be separate cooling units of Ostris Tuff (Langhin and Anderson, 1987). K-Ar age is about 23 Ma (Fleck and others, 1975; age corrected for new decay constants of Steiger and Jäger, 1977). One dated sample, with an age of 22.7 to 0.4 Ma, was collected from the east of Nevershine Hollow, in the north-central part of map area. Maximum thickness about 30 m, locally pinched out against pre-eruptive topography.

Mount Dutton Formation (Miocene and Oligocene)—Volcanic rock of intermediate (andesite to dacite) composition, together with local interbedded accumulations of felsic volcanic rock and tuffaceous sandstone. In accordance with the concepts of Parsons (1965, 1969) and Swadlow (1971) and in accordance with the concepts of Prosser (1973), most of the volcanic rocks (Tm) and of a more distal alluvial facies (Tta), both products of a series of stratovolcanoes oriented generally parallel to the present-day axis of the southernmost Tushar Mountains (Rowley and others, 1978; Anderson, 1980; Anderson, Rowley, and Blackman, 1986). Vent facies rocks consist mostly of lava flows and autoclasic flow breccia together with volcanic mudflow breccia in beds containing primary dikes indicating that they were deposited on the flanks of volcanoes. Rocks of this facies grade outward into weak argillic B horizon and stage II C horizon, which consist of a broad array of mostly volcanic mudflow breccia. The formation, its facies, and most members were originally dated by Anderson and Rowley (1977). K-Ar ages of 27-21 Ma were determined by Fleck and others (1975); ages corrected for new decay constants of Steiger and Jäger, 1977) in the distal to the base of a conspicuous, massive, resistant limestone bed, below which rocks are mostly red and above which they are mostly white. No such stratigraphic marker is present within the map area. The absence of this, or any other, established means of defining the two members has precluded mapping them separately here, although about two-thirds of the unit is "red" and the remainder "white." The overall sequence in map area nevertheless is lithologically similar to that south of map area, where the marker bed is present. Upper part consists of mostly soft, light gray to tan, friable, earthy and lacustrine breccia, and lower part consists of moderately resistant, mostly red, intertonguing argillaceous sandstone. Bedding is more uniform than that in lower part, which consists of soft to moderately resistant, mostly red, intertonguing argillaceous sandstone and calcareous fluvial siltstone, sandstone, and conglomerate. Conglomerate is the major rock type near base of normal part of accumulation at rates much slower than pedogenic amalgamation. Considered correlative to strata in southern Markagunt Plateau that Gregory (1949, 1950, 1951) assigned to Washwater Formation; Spieker (1964), however, demonstrated that type Washwater of northern Utah and adjacent parts of Wyoming does not extend east as far as Utah, but rather, he alone to the southern part of the state. Anderson and Rowley (1977), following the suggestion of Mackin (1960), discontinued use of the term "Washwater" in the southern High Plateaus and resurrected the name "Claron," which was first applied by Keith and Harder (1960) to strata equivalent to the Washwater in Iron Springs district of southwestern Utah. The age has not been established with certainty. Gregory (1950) reported "Cretaceous" basaltic flows (upper Washwater) near the eastern edge of map area (Fleck and others, 1975), age corrected for new decay constants of Steiger and Jäger, 1977). This sample (No. R-24) was accurately reported by Fleck and others (1975) as Ostris Tuff. Partial section at least 500 m thick exposed in the northwestern part of map area; thinning of the section is toward the south and west.

Aluvial facies (Miocene and Oligocene)—Soft to moderately resistant, mostly light to dark gray and brown volcanic mudflow breccia and subordinate conglomerate and sandstone, lava flows, autoclasic flow breccia, and felsic airfall and water laid tuff. The predominant lithology as defined is characterized by subangular to angular pebbles to boulder-size clasts of volcanic rock that are petrologically identical to rocks of the vent facies and that occur in a muddy matrix most commonly unsupported by direct contact between clasts. Ratio of clasts to matrix varies greatly in different mudflows, but is generally less than in mudflows of the vent facies. Thickness of mudflows ranges from one meter to several tens of meters. Clasts in individual mudflows may be monolithic or polyblastic. Conglomerate is largely of fluvial origin, and in places is void green; contains less than 5 percent phenocrysts of plagioclase, sanidine, biotite, hornblende, quartz, and Fe-Ti oxides and about 1 percent lithic fragments of typical flow rock of the member. K-Ar age determinations on lava flows of 26.2 to 0.5 and 25.0 to 0.8 Ma were made by Fleck and others (1975); ages corrected for new decay constants of Steiger and Jäger, 1977) from samples collected from localities shown in map area. Thickness ranges from less than 10 m to more than 200 m, and increases with distance from source vents, which probably were near Blue Valley.

Phonitic rock (Miocene or Oligocene)—Light gray, syndesmitic porphyry or monzonite porphyry consisting of generally finely crystalline, subhedral to subangular phenocrysts of plagioclase, hornblende, and magnetite in a holocrystalline, finely equigranular groundmass made up largely of orthoclase. Exposed only in one small outcrop in the mountains west of Lower Beaver Valley, where it gives the impression of being a large dike that discordantly cuts strata of Claron Formation (Anderson, 1965). However, this probably is a cupola extending from a larger (unroofed?) area about 5 km in diameter, dip away from a center not far from the outcrop; a radial fracture pattern over this center and overlying strata from the outcrop, a radial fracture pattern over this center and overlying strata from the outcrop, and a radial fracture pattern over this center and overlying strata from the outcrop, and a radial fracture pattern over this center and overlying strata from the outcrop. Age of the intrusion is probably Miocene; it domes and that post-dates the Buckskin Breccia, but its age with respect to younger units is unclear.

Bear Valley Formation (Oligocene)—Generally soft, light gray, yellow, or green, moderately to well sorted, fine to medium grained, "ash and pepper" tuffaceous sandstone of eolian origin, together with subordinate ash flow tuff, lava flows, conglomerate, and mudflow breccia. Occurs as only a small outcrop in the southern part of map area, where it consists largely of felsic ash flow tuff (Oligocene) and subordinate volcanic mudflow breccia (Anderson, 1965, 1971). Two members can be distinguished on the basis of composition. Upper member contains, in addition to porous, micaceous, sandstone, subordinate, amygdaloidal, biotite, Fe-Ti oxides, and rare quartz, considerable amounts of subangular, prismatic glass shards contributed to the sediment by contemporaneous volcanism; it also contains interbedded and lenses of welded and unwelded felsic ash flow tuff. Lower member is made up largely of sub-angular to well-sorted volcanic rock fragments and the same porous mineral grains. Both members are poorly to moderately well cemented by calcite (oolitic) that locally is altered to chlorite, which in places imparts a striking green color. Most of the unit is eolian and strongly crossbedded; measurement of crossbed attitudes indicates that wind directions were from the south and west (Anderson, 1971). Formation and members defined by Anderson (1971). K-Ar ages of about 25 Ma (Oligocene) have been determined from two interbedded volcanic beds within the formation (Fleck and others, 1975; age corrected for new decay constants of Steiger and Jäger, 1977). Thickness within map area is only several tens of meters; elsewhere it is greater than 350 m.

Buckskin Breccia (Oligocene)—Moderately resistant, light to medium gray and grayish-pink, poorly to moderately welded, crystal poor, ductile ash flow tuff, autoclasic flow breccia(?) and volcanic mudflow breccia(?). Characterized by abundant (as much as 50 percent of rock volume) distinctive porphyritic lithic clasts identical to volcanic rocks of Bull Run Creek and similar to Spry intrusion, which are exposed about 15 km east of map area (Grant and Anderson, 1979; Anderson and Grant, 1986; Anderson, Rowley, and others, 1989). Porphyritic clasts consist of phenocrysts of plagioclase, hornblende, biotite, augite, and Fe-Ti oxides in an aphanitic groundmass of sandstone and quartz. Less common types of clasts include welded and unwelded ash flow tuff, felsic ash fall tuff, and sedimentary rocks. Clasts are set in a devitrified glass matrix commonly enclosing vesipally deformed glass shards as well as fragmented grains of plagioclase, sanidine, hornblende, biotite, augite, and Fe-Ti oxides. Consists in places of a least four separate well bedded depositional units, bedded sequentially or separated by a few meters of tuffaceous sandstone. This section of these units identifies them as ash flow tuffs exhibiting compressed glass shards and other exotic features. Other units may have had the same origin, but any evidence of this is obscured by devitrification; alternatively, these units may have been formed by tuffaceous mudflow breccia or mudflow breccia. Described by Anderson and Rowley (1976). Type section is just south of southeastern corner of map area (Anderson, 1976; Anderson, Rowley, and others, 1989). Described in detail by Yarnack (1983). Age is Oligocene on the basis of intertonguing relationships with Iron Formation in the southeastern part of map area. Thickness varies greatly, from a few meters to more than 200 m.

Iron Formation (Oligocene)—Large formation, grayish-red, light, and light reddish-purple, densely welded, crystal poor ash flow tuff. Typically contains about 5-20 percent phenocrysts, 1-3 mm long, of plagioclase and minor augite and Fe-Ti oxides in a groundmass of devitrified shards. Generally the groundmass has the texture and appearance of unglauconitic andesite. Consists of one or locally two cooling units. Cooling units commonly contain a dark gray to brownish black basal vitrophyte. Cooling units locally exhibit secondary flow structures, including auto-brecciation and flow-foliation; they also contain numerous horizontal, pancake-shaped, light to medium gray tuff lentils that either represent collapsed pumice or are products of devitrification by trapped gas that probably formed during early stage cooling. Cooling units belong to Baldhill Tuff Member or Iron Springs Tuff Member, or both. The Baldhill Member and the Iron Springs Tuff Member were derived from the Great Basin west of the Iron Springs district of southwestern Utah. They flowed eastward into the map area, where they intertongued with Buckskin Breccia and locally pinched out against pre-eruptive topography. Erupted from a caldera at the Nevada Utah state line (Best and Grant, 1983, 1987). Ash-flow tuffs from the Nevada Range area are the most extensive regional ash flow sheets in the southern Great Basin and adjacent High Plateaus; unit extends over an area in excess of 50,000 km² (Shay and others, 1976). Exposed only in the southern part of map area. Intertongues with and locally pinches out in local volcanic, tuffaceous, and sedimentary strata (Tm) in the south. Defined by Mackin (1960). An age of 29.5 to 0.4 Ma was determined by Fleck and others (1975) on a sample obtained just south of the boundary of the map area. Thickness 15 to 25 m.

Local volcanic and tuffaceous sedimentary rocks (Oligocene)—Heterogeneous assemblage of locally deposited volcanic strata and tuffaceous sedimentary rocks. Base is largely of lower unit of volcanic origin (lava flow, ash flow tuff, autoclasic flow breccia, or volcanic mudflow breccia, but not air fall tuff or tuffaceous sandstone). Top is placed at base of Wah Wah Springs Formation, or where that formation is absent, at base of the most recent volcanic rock unit that is present in the map area. Includes 10 m thick, densely welded, crystal poor ash flow tuff, which is a K-Ar age of 31.9 to 0.5 Ma was determined by Fleck and others, 1975; age corrected for new decay constants of Steiger and Jäger, 1977). Sample locality is in southeastern part of map area. This tuff is overlain by a few tens of meters of tuffaceous sandstone. Maximum thickness 140 m.

Claron Formation (Oligocene and Eocene)—The southern High Plateaus, Claron Formation can be subdivided into two informal members, an upper "white" one and a lower "red" one; the contact between the two is placed at the base of a conspicuous, massive, resistant limestone bed, below which rocks are mostly red and above which they are mostly white. No such stratigraphic marker is present within the map area. The absence of this, or any other, established means of defining the two members has precluded mapping them separately here, although about two-thirds of the unit is "red" and the remainder "white." The overall sequence in map area nevertheless is lithologically similar to that south of map area, where the marker bed is present. Upper part consists of mostly soft, light gray to tan, friable, earthy and lacustrine breccia, and lower part consists of moderately resistant, mostly red, intertonguing argillaceous sandstone. Bedding is more uniform than that in lower part, which consists of soft to moderately resistant, mostly red, intertonguing argillaceous sandstone and calcareous fluvial siltstone, sandstone, and conglomerate. Conglomerate is the major rock type near base of normal part of accumulation at rates much slower than pedogenic amalgamation. Considered correlative to strata in southern Markagunt Plateau that Gregory (1949, 1950, 1951) assigned to Washwater Formation; Spieker (1964), however, demonstrated that type Washwater of northern Utah and adjacent parts of Wyoming does not extend east as far as Utah, but rather, he alone to the southern part of the state. Anderson and Rowley (1977), following the suggestion of Mackin (1960), discontinued use of the term "Washwater" in the southern High Plateaus and resurrected the name "Claron," which was first applied by Keith and Harder (1960) to strata equivalent to the Washwater in Iron Springs district of southwestern Utah. The age has not been established with certainty. Gregory (1950) reported "Cretaceous" basaltic flows (upper Washwater) near the eastern edge of map area (Fleck and others, 1975), age corrected for new decay constants of Steiger and Jäger, 1977). This sample (No. R-24) was accurately reported by Fleck and others (1975) as Ostris Tuff. Partial section at least 500 m thick exposed in the northwestern part of map area; thinning of the section is toward the south and west.

Structural features

Contact—Dashed where approximately located (in cross section)

Outline of gravity slide block

Fault—Most are high-angle normal faults. Dashed where inferred or approximately located; dotted where concealed; dotted where uncertain. Where relative offset is known, bar and coral on downthrown side. Additional details on fault and lineament patterns are given by Anderson and Decatur (in press)

Lineament—Structural lineament identified in the field or on aerial photographs. Probably represents the trace of a joint or a fault of small displacement

Breakaway scarp—Headwall trace of a landslide (toreva) mass that moved as a coherent block, upslope on downthrown side

Sample locality of isotopically dated rock—Shown as million years (Ma). Determined by Fleck and others (1975); corrected for new decay constants given by Steiger and Jäger, 1977). Best and others (1980), age uncorrected, and H.H. Mehnert (this report; age uncorrected) by dashed line

Beaver Member (Oligocene)—Light to dark gray, pink, tan, light green, vivid-green, reddish-brown (due to oxidation), and yellow, dense, thick to massively bedded andesite porphyry containing 30-50 percent phenocrysts of plagioclase (2-10 mm long) and lesser amounts of biotite (2-5 mm) and hornblende (1-5 mm), with accessory Fe-Ti oxides, pyroxene, and rare quartz in a cryptocrystalline or devitrified glassy groundmass. Most of the unit accumulated as a series of viscous lava flows that formed several volcanic domes, but in places also includes autoclasic flow breccia and volcanic mudflow breccia and thin beds of conglomerate and sandstone in which clasts consist largely of the same lithology as the lava flows. In the Blue Valley area, includes a stratified sequence of tuffaceous sandstone, volcanic mudflow breccia, and felsic tuff (Decatur, 1979; Anderson and Decatur, 1981). Tuff in place is void green; contains less than 5 percent phenocrysts of plagioclase, sanidine, biotite, hornblende, quartz, and Fe-Ti oxides and about 1 percent lithic fragments of typical flow rock of the member. K-Ar age determinations on lava flows of 26.2 to