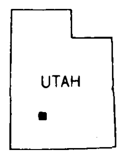
GEOLOGIC MAP OF THE CIRCLEVILLE QUADRANGLE, BEAVER, PIUTE, IRON, AND GARFIELD COUNTIES, UTAH

By John J. Anderson and Peter D. Rowley
U.S. Geological Survey



UTAH GEOLOGICAL AND MINERAL SURVEY
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MAP 82 **1986**

UTAH GEOLOGICAL AND MINERAL SURVEY

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GEOLOGIC MAP OF THE CIRCLEVILLE QUADRANGLE, BEAVER, PIUTE, IRON, AND GARFIELD COUNTIES, UTAH

By John J. Anderson[1] *and Peter D. Rowley*[2]
U.S. Geological Survey

INTRODUCTION

The western half of the Circleville quadrangle is in the southeastern Tushar Mountains, the eastern half in the Sevier River ("Long") valley. These areas are in the High Plateaus subprovince which is structurally transitional between the block-faulted Basin and Range Province to the west and the more stable Colorado Plateaus of which it is a part.

The Marysvale volcanic field, one of the largest eruptive piles in the western United States, straddles the High Plateaus and extends into the Basin and Range Province. The quadrangle contains part of one of the most voluminous and extensive accumulations of this volcanic field, the Mount Dutton Formation. It consists of rock erupted from a series of clustered stratovolcanos distributed in a crudely defined east-trending zone (Rowley and others, 1978) across the southern Tushar Mountains. The formation extends from just east and southeast of the area of this map, in the southwestern Sevier Plateau, to the northern Black Mountains, about 30 miles (48 km) to the west. Because of repetition by numerous high-angle dip-slip faults and because of the resistant nature of the rocks, a significant part of this volcanic vent complex is well exposed in the quadrangle, particularly on the imposing east-facing scarp west of Oak and Cottonwood Basins in the northwestern part of the quadrangle and in road cuts along highway U.S. 89 in Circleville Canyon. The Osiris Tuff, a regional ash-flow tuff interbedded high in the Mount Dutton section, and minor accumulations of volcanic rocks of local origin that post-date the Mount Dutton Formation also occur in the quadrangle. General discussions of the geology in and near the Circleville quadrangle may be found in Rowley (1968), Anderson and others (1975), Rowley and Anderson (1975), Rowley and others (1978, 1979), Shawe and Rowley (1978), and Steven and others (1978, 1979). Geologic mapping has been done to the north of the mapped area by Callaghan and Parker (1962) and Cunningham and others (1979, 1983), to the west by Anderson (1986), to the east by Rowley (1968), and to the south by Anderson (1965).

STRATIGRAPHY

Rocks exposed in the Circleville quadrangle total nearly 5,000 feet (1524 m) in thickness and range in age from Oligocene to Holocene. Most belong to central-vent stratovolcanos of the Oligocene and Miocene Mount Dutton Formation; rock types such as lava flows, autoclastic flow breccia, and volcanic mudflow breccia make up the bulk of this unit. Other volcanic units are intertongued with and overlie the Mount Dutton Formation. The Osiris Tuff is a regional ash-flow tuff high in the Mount Dutton section. Overlying units include the mafic lava flows of Circleville Mountain and the mafic gravels of Gunsight Flat, local units that have not been formally named. During late Tertiary and Quaternary block faulting activity, downthrown blocks locally filled with clastic sediments derived from nearby upthrown blocks. Circle Valley is the largest of these grabens, and it was partially filled with poorly consolidated upper Tertiary sedimentary strata of the Sevier River Formation and by unconsolidated Quaternary sediments assigned to several informal units.

TERTIARY SYSTEM

Mount Dutton Formation

The most commonly exposed rocks in the Circleville quadrangle are volcanic units of intermediate (dacite to

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andesite) composition interbedded locally with felsic and mafic volcanic rock and tuffaceous sandstone. These rocks belong to the Mount Dutton Formation of Oligocene and Miocene age. In accordance with the concepts of Parsons (1965, 1969) and Smedes and Prostka (1973), the formation has been subdivided into a vent facies and an alluvial facies, both the products of a series of stratovolcanos trending more-or-less eastward across what today comprises the southernmost Tushar Mountains. Vent facies rocks, the near-source products of the stratovolcanos, consist of lava flows and autoclastic flow breccia and subordinate volcanic mudflow breccia, conglomerate, and sandstone. They also include all volcanic strata that exhibit primary dips resulting from their emplacement by an active volcano onto the flanks of its growing edifice. Vent facies rocks grade outward into, and intertongue with, the alluvial facies, which forms a broad apron of volcanic mudflow breccia and subordinate conglomerate, sandstone, lava flows, and flow breccia. The map units, originally defined by Anderson and Rowley (1975), are described separately below.

Vent facies: This unit consists of generally medium- to dark-gray and grayish-brown, generally dense lava flows and autoclastic flow breccia making up at least one-half of the exposed section, and subordinate volcanic mudflow breccia, conglomerate, tuffaceous sandstone, and felsic ash-flow, air-fall, and water-laid tuff. Both the flows and the clasts in the sedimentary beds consist largely of amphibole and(or) pyroxene andesite and dacite; textures range from aphanitic to conspicuously porphyritic with phenocrysts of plagioclase, hornblende, and(or) augite set in a microcrystalline and largely devitrified glass groundmass. The unit locally includes small accumulations of dark-gray to black mafic breccia of unknown source and affinity. The intermediate rocks were derived in part from fissure eruptions and stratovolcanos located within the present quadrangle, producing lava flows from a few feet to many tens of feet thick. Potassium-argon age determinations of about 27 to 21 m.y.* (Fleck and others, 1975) indicate a late Oligocene and Miocene age for the formation. Although no complete section of the vent facies is exposed, maximum thickness within this quadrangle is in excess of 3,000 feet (915 m). The section thins toward the south and east, while about 15 miles north of the quadrangle boundary, the unit laps onto and intertongues with slightly older and contemporaneous volcanic rocks of the central Marysvale field.

* When necessary, isotopic ages have been corrected for the new decay constants of Steiger and Jäger (1977).

Alluvial facies: Alluvial facies rocks, exposed only in the southern part of the quadrangle, consist of soft to moderately resistant, generally light- to medium-gray volcanic mudflow breccia, conglomerate, and tuffaceous sandstone that comprise over one-half of the exposed section. The remainder is made up of lava flows and autoclastic flow breccia. Both the clasts in the breccia and the lava flows consist of crystal-poor andesite and dacite containing mostly sparse small phenocrysts of hornblende in a microcrystalline and largely devitrified glass groundmass. The predominant mudflow breccia is characterized by subrounded to angular clasts of volcanic rock identical to that of the vent facies, most commonly suspended in a muddy to sandy matrix. The ratio of clasts to matrix varies greatly in different mudflows, and the thickness of the flows ranges from a foot to several tens of feet. A largely fluvial conglomerate, and the tuffaceous sandstone of partly fluvial and partly eolian origin, consist almost exclusively of reworked volcanic detritus, much of which doubtlessly was derived from the Mount Dutton volcanic units. Conglomerate and sandstone occur as local channel fillings and as lenses ranging from a few feet to a few tens of feet thick. Intertonguing with the vent facies, the alluvial facies has no complete section exposed in this quadrangle where its thickness is at least 1,000 feet (305 m). It thickens eastward; along the west-facing scarp of the southern Sevier Plateau, about 5 miles (8 km) to the southeast, it is about 3,000 feet (915 m) thick.

Sandstone member: Light- to dark-gray, greenish-gray, and yellowish-gray, soft and friable, eolian and fluvial tuffaceous sandstone and fluvial conglomerate occur at or near the top of the Mount Dutton Formation. The tuffaceous sandstone consists largely of sub-angular to subrounded volcanic rock fragments together with 5 to 25 percent grains of plagioclase and subordinate hornblende, pyroxene, and Fe-Ti oxides; the sand is poorly cemented by zeolite (clinoptilolite?). The conglomerate consists of granule- to cobble-sized clasts of volcanic rock in a matrix of volcanic sandstone. Where exposures are few and poor, the sandstone member is mapped with vent facies rock of the Mount Dutton Formation. The age of the unit is Miocene, based on its stratigraphic position, and its maximum thickness is about 400 feet (122 m).

Dikes: Dikes of andesite, porphyritic amphibole andesite, and porphyritic pyroxene andesite occur in this quadrangle as large tabular bodies cutting strata of the Mount Dutton Formation. The dikes are identical in lithology to flows and clasts of the Mount Dutton Formation, and at least some of the dikes were the source of Mount Dutton lava flows.

Osiris Tuff

The Osiris Tuff, of Miocene age, consists of ledge-forming, reddish-brown to pinkish- or purplish-gray, densely welded vitric-crystal ash-flow tuff made up of 10 to 20 percent small (1 to 3 mm) phenocrysts of plagioclase, subordinate sanidine, and minor biotite, augite, and Fe-Ti oxides set in a groundmass of devitrified glass shards and dust; the rock commonly has the texture and appearance of unglazed porcelain. The unit in many places includes a brownish-black basal vitrophyre 1 to 15 feet (0.30 - 5 m) thick and commonly contains pancake-shaped ash-flow tuff lenticules. In some places the Osiris Tuff is capped by a light-gray to cream pumice-like vapor phase zone. Secondary flowage and brecciation features also are common in the upper part of the tuff.

Within the quadrangle, the Osiris Tuff is intertongued in the upper part of the Mount Dutton Formation; its source area is in the northern Sevier Plateau where its eruption led to the formation of the Monroe Peak caldera (Cunningham and others, 1983; Steven and others, 1984). The unit was used informally by Williams and Hackman (1971), formally adopted by Anderson and Rowley (1975), and mapped by Willard and Callaghan (1962) northeast of the quadrangle boundary as the quartz latite member of the Dry Hollow Formation, a term abandoned by Steven and others (1979). K-Ar age of the Osiris is about 23 m.y. (Fleck and others, 1975); its thickness ranges from zero to 100 feet (0 - 31 m); and locally it pinches out against pre-existing topography.

Mafic lava flows of Circleville Mountain

In the northwestern part of the quadrangle, this sequence caps the high skyline ridge which is the continuation of Circleville Mountain, just west of the mapped area. The sequence consists of resistant, dark-gray to black, vesicular to dense lava flows and autoclastic flow breccia of porphyritic basalt(?) or basaltic andesite. The groundmass is hyalopilitic, with microlites of plagioclase, pyroxene, and Fe-Ti oxides; in it are set abundant (10 to 20 percent), large (2 to 10 mm), subhedral phenocrysts of augite and minor hypersthene, and small amounts of plagioclase generally 1 mm or so in size. As the rock generally weathers to light gray or light brownish-gray, the pyroxene phenocrysts stand out in bold color contrast to the groundmass; thus fragments of the unit found several miles from the nearest outcrop area are readily recognizable.

Maximum thickness of these lava flows is about 500 feet (152 m) in the quadrangle, and about twice this thickness immediately west of the map area. The flows were emplaced into structural and(or) erosional lows developed on older rocks. Their age is 23 m.y. (Fleck and others, 1975) based on two samples. In Little Dog Valley, a source area just west of the southwestern part of this quadrangle, several large, composite dikes of the same lithology as the flows cut strata of the Mount Dutton Formation.

Mafic gravels of Gunsight Flat

This unit consists of poorly consolidated conglomerate and fanglomerate made up almost exclusively of gravel derived from the mafic lava flows of Circleville Mountain and other mafic lava flows exposed north and west of the mapped area. The gravels appear to have been shed from paleo-fault scarps located in the Circleville Mountain quadrangle just to the west (Anderson, 1985). Contacts between the gravel and the mafic lava flows of Circleville Mountain are poorly exposed and therefore are only approximately located on the map. These relations, however, suggest that the two units interfinger and are generally contemporaneous, giving the mafic gravels of Gunsight Flat an age of about 23 m.y. The thickness in this quadrangle is about 300 feet (91 m); northwest of the mapped area, it is more than 1,000 feet (305 m).

Sevier River Formation

Erosion of the upfaulted High Plateaus led to the deposition of clastic sediments in nearby downfaulted topographic lows. These deposits, largely fluvial, were defined as the Sevier River Formation by Callaghan (1939). In the quadrangle they consist of poorly to moderately consolidated, light-gray, tan, pinkish-gray, and white, silty pebbly sandstone and conglomerate that have a maximum exposed thickness of about 100 feet (31 m), but probably they are considerably thicker under Circle Valley in the eastern part of the quadrangle. Airfall tuff beds in the formation in the Clear Creek area about 25 miles (40 km) to the north have yielded fission-track ages of 14 and 7 m.y. (Steven and others, 1979), indicating a Miocene age. The upper part of the unit, however, locally may be Pliocene or even as young as Pleistocene. Since contacts of the formation are poorly exposed, they are only approximately located on this map.

QUATERNARY SYSTEM

Older alluvial fan and terrace deposits

This unit includes alluvial fan, pediment, and terrace deposit remnants on dissected benches along the Sevier River. Deposits consist of unconsolidated to poorly cemented silt, sand, and gravel; clasts commonly are coated with caliche. Holocene and Pleistocene(?) in age, the maximum thickness of the unit is about 50 feet (15 m).

Piedmont slope deposits

A unit of unconsolidated, poorly sorted silt, sand, and gravel occurring as thin mantles on pediments and as thicker accumulations in alluvial fans, it locally occurs within downfaulted depressions. Most of these deposits are dissected by present streams with most pediments graded to erosion levels higher than present ones. Alluvium of small drainages is included in the unit as well as local colluvium, alluvial slope wash, and talus. It is of Holocene and Pleistocene age. Maximum exposed thickness is about 50 feet (15 m), but the unit may be considerably thicker in large downfaulted depressions such as Oak Basin.

Landslide debris

Landslide debris consists of mostly angular and very poorly sorted material that moved downslope from nearby bedrock to form deposits of lobate form as well as broad aprons mantling steep valley walls and fault scarps. The Holocene unit also includes talus and colluvium and has a thickness typically of a few tens of feet.

Playa lake deposits

Playa lake deposits consist of lacustrine clay, silt, and sand deposited in a small, undrained depression in the northeastern part of the quadrangle. The age of this unit is Holocene with a thickness as much as several tens of feet.

Floodplain and channel deposits

Channel deposits of silt, sand, and gravel, locally cobbly and bouldery, along the Sevier River as well as clay and silt overbank deposits on the floodplain are included in this unit. The age of these sediments is Holocene and maximum thickness is about 30 feet (9 m).

Alluvial fan and talus deposits

This unit consists of alluvium and alluvial fans of small, intermittent streams emptying into the Sevier River valley, together with minor accumulations of talus. A heterogeneous mixture of silt, sand, and gravel of Holocene age, its maximum thickness is about 30 feet (9 m).

Alluvium

Consisting of silt, sand, and gravel deposited by intermittent and perennial streams in their channels, on bordering floodplains, and as terminal alluvial fans, locally the unit also includes colluvium, alluvial slope wash, and talus. It is of Holocene age with a maximum thickness of several tens of feet.

STRUCTURAL GEOLOGY

The structural pattern in the Circleville quadrangle is dominated by north-northeast-striking, high-angle, dip-slip faults. Uplift along some of these faults has produced the high Tushar Mountains in the northwestern part of the map area; the sub-parallel but anastomosing pattern of these range front faults, most of which have the same sense of displacement, resembles the pattern along other range fronts in the southern High Plateaus. Circle Valley in the southeastern part of the quadrangle is part of a large downfaulted structure that separates the Tushar Mountains and northern Markagunt Plateau to the southwest from the fault-bounded Sevier Plateau east of the Circleville quadrangle. Circle Valley area faults reveal that faulting was as intense within the intermontane valleys of the southern High Plateaus as it was within the plateaus themselves.

Faults that strike north-northwest are present in the northwestern part of the Circleville quadrangle. Together with the more common north-northeast-trending ones, they form a rhombic fault pattern that is seen throughout the southern High Plateaus. Immediately to the north of the map area the range front of the Tushar Mountains is defined by the north-northwest-trending fault set to produce a zigzag range front that likewise is typical of the southern High Plateaus.

Displacements along most faults in the quadrangle are poorly known because marker beds are uncommon. Faults defining the high scarp west of Cottonwood and Oak Basins, however, have a combined throw at least as great as the height of the scarp, which is over 2,000 feet (610 m). Proof of this is provided by the Osiris Tuff, which crops out at an elevation of 7,400 feet (2591 m) east of, and 8,500 feet (2590 m) west of, Cottonwood Basin, and at an elevation of 9,700 feet (2957 m) in the adjacent Circleville Mountain quadrangle (Anderson, 1986).

The major displacements along the faults of the southern High Plateaus appear to date to Pliocene and Pleistocene time (Rowley and others, 1981). Faulting may have begun much earlier, however, inasmuch as extensional tectonics generally are associated in Utah with compositionally bimodal (alkali basalt and alkali rhyolite) volcanism which began in neighboring quadrangles about 23 m.y. ago (Anderson and Rowley, 1975; Rowley and others, 1979). The mafic lava flows of Circleville Mountain may represent some of the first of these bimodal rocks. Faulting continued into Quaternary time, as demonstrated by small fault scarps cutting Quaternary sediments in several places in the quadrangle; none of these sediments has been demonstrated to be Holocene, however. Several lineaments also show on this map. If these represent faults of small displacement, they would indicate that faulting has continued into Holocene time, because one of these lineaments cuts alluvium interpreted to be of Holocene age.

ECONOMIC GEOLOGY

By constrast with the eruptive centers near the central part of the Marysvale volcanic field, those of the Mount Dutton Formation in general, and of the Circleville quadrangle in particular, have yet to yield any metallic mineral deposits. At most, small areas of hydrothermally altered rocks have been identified. Plutonic equivalents of the volcanic rocks exposed are not in the quadrangle, whereas plutonic rocks are widespread in the mineralized areas to the north (Cunningham and others, 1983). Apparently the magma chambers that supplied the volcanic rocks exposed in the quadrangle are much deeper, and any minerals that might be associated with these chambers remain buried.

Gravel and fill have been mined from several pits in the Sevier River Formation west of Circleville. Gravel might also be mined from several Quaternary alluvial units.

GEOLOGIC HAZARDS

Earthquakes have been felt in the Circleville area in the historic past, but there is no recorded breakage of the surface or evidence to indicate that these earthquakes resulted from the movement of local faults. Some faults have displaced Quaternary sediments, but none of these sediments has been proved to be as young as Holocene. One lineament, which may be a fault trace, has been mapped crossing alluvium interpreted to be of Holocene age and might indicate relatively recent faulting. Thus, despite the abundant faults in the Circleville quadrangle, any potential hazards posed by earthquakes are difficult to assess. Construction of houses or major buildings on any mapped fault, especially those that show evidence of Quaternary movement, should be avoided.

Flooding by the Sevier River would appear to be a much more significant danger. The anomalously small alluvial fans of drainages that encroach on that river's floodplain suggest that the river has only recently occupied its floodplain and trimmed these alluvial fans to the edge of that floodplain. Most of the town of Circleville is only 10 feet (3 m) or so above the river's usual level and is immediately north of Circleville Canyon, a likely catchment area and "funnel" for flood waters.

WATER RESOURCES

The Sevier River provides a perennial source of water for human and agricultural uses in Circle Valley and elsewhere, but its discharge throughout the year is not great enough to support large-scale irrigation projects. Cottonwood Creek is a perennial stream that supplies much of the water used by the residents of Circleville. Abundant ground water may be present within the sediments that fill Circle Valley, Oak Basin, and Cottonwood Basin but, if so, it has yet to be exploited to any great degree. Water is scarce elsewhere within the quadrangle; most that is used by humans comes from small springs that probably are controlled by faults. Cattlemen pipe the water from such springs into troughs.

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Plate 1
Utah Geological and Mineral Survey Map 82
Geologic Map of the Circleville Quadrangle

Base from U.S. Geological Survey: Circleville Quadrangle, 1966

SCALE 1:24 000

CONTOUR INTERVAL 40 FEET
DOTTED LINES REPRESENT 20-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

Field mapping by authors in 1969-70, 1978, 1984
Field checked 1984

K.D. Brown and D.A. Jenkins, Cartographers

UTM GRID AND 1966 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

QUADRANGLE LOCATION

GEOLOGIC MAP OF THE CIRCLEVILLE QUADRANGLE, BEAVER, PIUTE, AND GARFIELD COUNTIES, UTAH

by
John J. Anderson, Peter D. Rowley, and John T. Blackman
U.S. Geological Survey

1986

UTAH GEOLOGICAL AND MINERAL SURVEY
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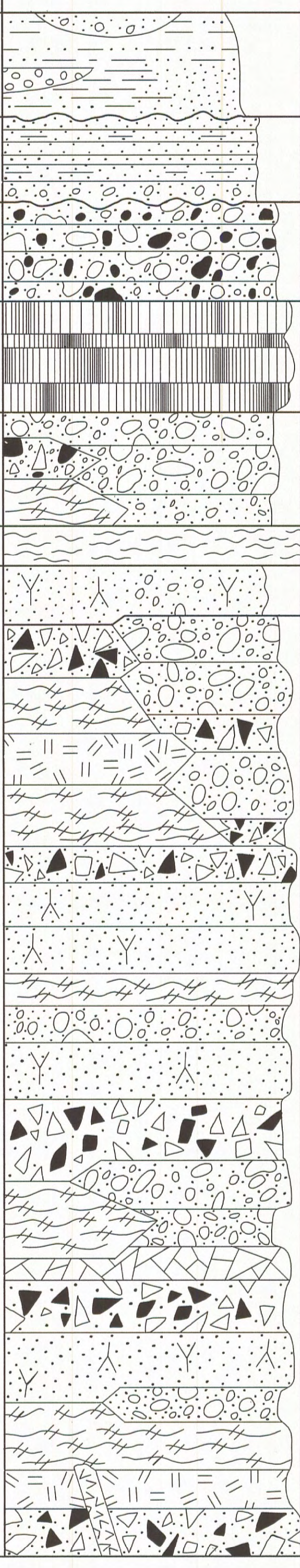
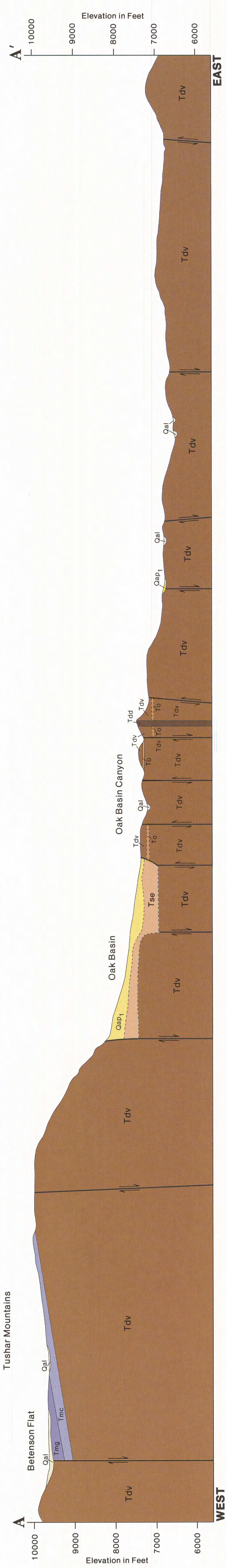
Geologic Map of the Circleville Quadrangle

FORMATION	SYMBOL	LITHOLOGY	THICKNESS feet (meters)
Surficial deposits	Qal Qaf$_1$ Qan Qpm Qms Qap$_1$ Qaf$_2$		0-300 (0-92)
Sevier River Formation	Tse		0-250+ (0-76+)
Mafic Gravels of Gunsight Flat	Tmg		0-300 (0-92)
Mafic Lava flows of Circleville Mountain	Tmc		0-500 (0-153)
MOUNT DUTTON FORMATION: Osiris Tuff	To		0-50 (0-15)
			0-400 (0-122)
Vent facies	Tdv		3000+ (915+)
Alluvial facies	Tda		
Dikes	Tdd		1000+ (305+)





DESCRIPTION OF MAP UNITS

QUATERNARY

Qal Alluvium—*Unconsolidated silt, sand, and gravel along active streams and washes.*

Qaf$_1$ Alluvial fan and talus deposits—*heterogenous mix of sand, silt, and gravel with minor talus from intermittent streams.*

Qan Floodplain and channel deposits—*silt, sand, and gravel, locally cobbly and bouldery.*

Qpm Playa lake deposits—*lacustrine clay, silt, and sand.*

Qms Landslide debris—*disaggregated rock and surficial deposits.*

Qap$_1$ Piedmont slope deposits—*poorly sorted, unconsolidated silt, sand, and gravel on sloping surfaces from deposition (alluvial fans) and erosion (pediments).*

Qaf$_2$ Older alluvial fan and terrace deposits—*unconsolidated to poorly sorted silt, sand, and gravel.*

UNCONFORMITY

TERTIARY

Tse Sevier River Formation—*poorly to moderately consolidated, light-gray, tan, pinkish-gray, and white silty-pebbly sandstone and conglomerate with local air-fall tuffs.*

UNCONFORMITY

Tmg Mafic gravels of Gunsight Flat—*poorly consolidated conglomerate and fanglomerate derived from Tmc and Tmb.*

Tmc Mafic lava flows of Circleville Mountain—*resistant, dark-gray to black, vesicular to dense porphyritic lava flows that resemble plateau basalts.*

To Osiris tuff—*ledge-forming, reddish-brown to pinkish- or purplish-gray, densely welded, vitric-crystal ash-flow tuff.*

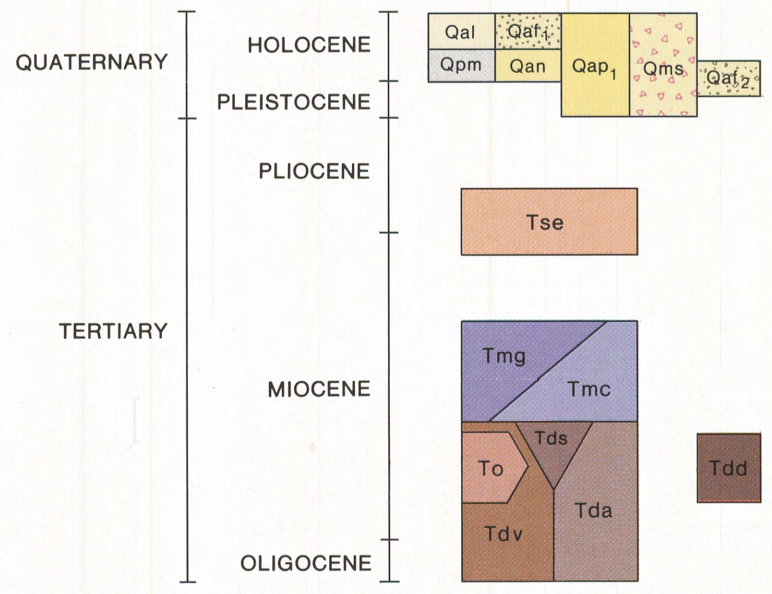
Mount Dutton Formation

Tdv Vent facies—*medium- to dark-gray and gray-brown, dense lava flows and autoclastic flow-breccia.*

Tda Alluvial facies—*gray and brown volcanic mudflow-breccia, conglomerate, and tuffaceous sandstone.*

Tdd Dikes—*dikes of porphyritic amphibole andesite.*

Tds Sandstone member—*soft, light-gray, yellow or tan, cross-bedded, zeolite-cemented tuffaceous sandstone.*



CONTACT
Dashed where approximately located

FAULT
Dashed where location inferred; queried where probable; dotted where covered; bar and ball on downthrown side

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STRIKE AND DIP OF BEDS

IDENTIFIABLE STRUCTURAL LINEAMENT

Approximate location of vent of central stratovolcano