Text and references to accompany Nevada Bureau of Mines and Geology Map 118

GEOLOGY OF THE CARSON CITY 30 X 60 MINUTE QUADRANGLE, NEVADA

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GLACIAL DEPOSITS

Qm **Morainal deposits, undivided (Holocene and Pleistocene)** Till composed of unsorted, angular to subrounded, andesitic and granitic gravel in sandy and clayey matrix. Includes considerable outwash deposits. Probably includes deposits belonging to the Donner Lake, Tahoe, and Tioga glaciations, and small areas underlain by Neoglacial till.

Qmti **Moraines of Tioga glaciation (late Pleistocene)** Weakly weathered, slightly compacted, unsorted till composed of andesitic and granitic gravel in sandy and clayey matrix. Forms lateral moraines and breached remnants of low terminal moraines within more extensive morainal deposits of the Tahoe glaciation. Exposed near Third Creek and Galena Creek south to east of Mt. Rose.

Qmta **Moraines of Tahoe glaciation (late Pleistocene)** Moderately weathered, weakly compacted, unsorted till composed of andesitic and granitic gravel in sandy and clayey matrix. Well preserved lateral moraines, but terminal moraines are completely lacking (Thompson and White, 1964). Exposed near Third Creek and Galena Creek south to east of Mt. Rose.

Qmd **Moraines of Donner Lake glaciation (late Pleistocene)** Deeply weathered, moderately well consolidated, unsorted till composed of andesitic and granitic gravel in sandy and clayey matrix. Characterized by complete destruction of original topographic morainal form and by position high on sides of valleys (Thompson and White, 1964). Exposed near Incline Lake and Browns Creek, south and east, respectively, of Mt. Rose.

Qo **Outwash deposits, undivided (late Pleistocene)** Sand, silt, and gravel. Locally contains subrounded clasts. Exposed within and near Incline Village north of Lake Tahoe and in three small outcrops between Slide Mountain and Washoe Lake.

Qoti **Outwash deposits of Tioga glaciation (late Pleistocene)** Poorly sorted sand, silt, and gravel. Exposed only in a small area in lower part of Galena Creek east of Mt. Rose.

Qota **Outwash deposits of Tahoe glaciation (late Pleistocene)** Slightly weathered to locally unweathered gravel composed of volcanic and granitic boulders and large cobbles in a sandy matrix. Forms pediment and thin fan deposits. Present in a large area 8 to 15 km south of Reno, in areas along Truckee River in the northwesternmost part of quadrangle, and in small areas near Reno.

Qod **Outwash deposits of Donner Lake glaciation (late Pleistocene)** Deeply weathered, poorly sorted gravel composed of andesite and rare granitic rock clasts in sandy and muddy matrix (Bonham and Rogers, 1983). Deposits near Reno consist of unconsolidated gravel that contains well rounded clasts and interbedded coarse sand. Forms extensive pediment and thin fan deposits 5 to 10 km south of Reno, smaller areas of strath-terrace gravel within and near Reno, small outcrops near Truckee River in northwesternmost part of quadrangle, and small outcrops of gravel 8 km southeast of Reno.

ALLUVIAL DEPOSITS

Qa **Alluvium in small mountain valleys (Holocene and Pleistocene)** Gravel, sand, and silt of alluvial fans, intermittent streams, and lakes. Generally little eroded. Age relative to other alluvial deposits in quadrangle uncertain or unknown.

Qfly **Younger fluvial deposits (Holocene and late Pleistocene)** Sand, silt, and local intercalated gravel, forming thin, widespread alluvial-plain deposits. Deposited by low-gradient streams. Forms extensive areas in Truckee Meadows and Carson Valley; in parts of Steamboat, Pleasant, and Washoe Valleys; and in an area about 1 to 10 km southwest of Silver Springs.

Qflo **Older fluvial deposits (late and middle Pleistocene)** Sand, silt, and gravel similar to younger fluvial deposits except that unit is present as dissected remnants, is moderately weathered, and has moderately well developed soil. Present in Truckee Meadows and in Carson Valley.

Qfp **Flood-plain alluvium (Holocene and late Pleistocene)** Sand, silt, and gravel. Stream channel and overbank deposits of low-gradient meandering streams. Forms Holocene deposits along perennial streams (Truckee River, Carson River, Walker River, Streamboat Creek) and deposits in Adrian and Mason Valleys related to older, inactive, stream systems.

Qba **Braided alluvial deposits in mountain canyons (Holocene and late Pleistocene)** Poorly sorted gravel, sand, and silt of intermittent braided streams.

Qfy **Younger alluvial-fan deposits (Holocene and late Pleistocene)** Poorly sorted gravel, sand, and silt deposited during intermittent stream and sheetflow. Forms fan-shaped constructional deposits along mountain fronts. Clast size generally decreases and sorting increases downfan toward distal margins of fans. Widely exposed in quadrangle.

Qfi **Intermediate alluvial-fan deposits (late and middle Pleistocene)** Poorly sorted gravel, sand, and silt lithologically and texturally similar to younger alluvial-fan deposits; distinguished by degree of dissection, characterized by numerous well defined drainage channels and relief of as much as about 5 m. Spotty distribution; mostly in upper parts of piedmont slopes.

Qfo **Older alluvial-fan deposits (middle and early Pleistocene)** Poorly sorted gravel, sand, and silt lithologically and texturally similar to intermediate alluvial-fan deposits; distinguished by degree of dissection. Generally deeply dissected by numerous channels; relief commonly from 5 to 30 m. Spotty distribution; mostly in upper parts of piedmont slopes.

QTg **Gravel and sand (early Pleistocene and Pliocene)** Moderately thick (20 to 100 m) deposits of poorly to moderately sorted fluvial gravel, sand, and silt. Highly dissected by deep channels, but original low-relief constructional surfaces are preserved locally. Most extensively exposed in a 20-km-long west-northwest-trending belt from Adrian Valley to Bull Canyon in east-central part of quadrangle. Other large deposits are present near Reno, near Jacks Valley on the west side of Carson Valley, near the Carson River east of Carson City, near Dayton, on the south side of the Virginia Range about 10 km west of Silver City, and in the valley between the Pine Nut Mountains to the west and the Buckskin Range to the east. Poorly dated and probably not consistently divided from separately mapped Miocene and Pliocene sedimentary units or from Pliocene and lower Pleistocene pediment deposits.

Qpy **Younger pediment deposits (Holocene and late Pleistocene)** Deposits of poorly sorted gravel, sand, and silt lithologically, texturally, and morphologically similar to alluvial-fan deposits except that these younger pediment deposits are interpreted as veneers on erosion surfaces on poorly consolidated Miocene sedimentary rocks. Forms uneroded deposits in small valleys of intermittent streams in lower parts of western slope of Pine Nut Mountains west of Mineral Peak.

Qpi **Intermediate pediment deposits (late and middle Pleistocene)** Deposits of poorly sorted gravel, sand, and silt lithologically, texturally, and morphologically similar to alluvial-fan deposits except that these intermediate pediment deposits are present as veneers on erosion surfaces cut into bedrock and older alluvial deposits. Slightly to moderately dissected; distinguished locally from younger pediment deposits by relatively higher topographic position and from older pediment deposits by relatively lower topographic position. Most extensively developed on lower piedmont slopes in areas underlain by poorly consolidated Miocene and Pliocene sedimentary rocks and in valleys and low piedmont slopes in areas underlain by Mesozoic granitic rocks. The most extensive areas of exposure are: (1) west of Reno, (2) in Carson Valley and adjacent mountain areas, particularly lower parts of western slope of the Pine Nut Mountains, and (3) in the Adrian Valley to Bull Canyon area south of the Carson River in the east-central part of the quadrangle.

Qpo **Older pediment deposits (middle and early Pleistocene)** Deposits of poorly sorted gravel, sand, and silt lithologically, texturally, and morphologically similar to alluvial-fan deposits except that these older pediment deposits are present as veneers on erosion surfaces cut into bedrock and older alluvium. Moderately to highly dissected; distinguished locally from younger pediment deposits by relatively higher topographic position and from pediment deposits (unit QTp) of Pliocene and early Pleistocene age by relatively lower topographic position. Most extensively developed on lower piedmont slopes in areas underlain by poorly consolidated Miocene and Pliocene sedimentary rocks. The most widespread areas of exposure are: (1) near and west of Reno, (2) in lower parts of the western slope of Pine Nut

Mountains west of Mineral Peak, (3) in Spring Valley 4 km west of Dayton, (4) in the Virginia Range, particularly on the southeast flank 2 to 20 km southwest of Silver Springs, and (5) in the Adrian Valley to Bull Canyon area south of the Carson River in the east-central part of quadrangle.

QTp **Pediment deposits (early Pleistocene and Pliocene)** Deposits of poorly sorted gravel, sand, and silt lithologically, texturally, and morphologically similar to alluvial-fan deposits except that these pediment deposits are present as veneers on erosion surfaces cut into Mesozoic and Tertiary rocks. Highly dissected. Distinguished from other pediment deposits by generally deep dissection and relatively high topographic position. Restricted to Pine Nut Mountains where unit is present as (1) widespread deposits on an erosion surface cut on Miocene sedimentary rocks, and to a lesser extent on Mesozoic granitic rocks, extending from the east side of Carson Valley to near Mineral Peak, (2) deposits on an erosion surface cut on Miocene sedimentary rocks in Eldorado Canyon, and (3) a thin veneer of gravel on an erosion surface cut on Tertiary dacite and andesite in a 13-km-long north-trending band extending from near Churchill Canyon to 6 km northeast of Como. Pediment gravels in the belt from Churchill Canyon to northeast of Como are present at elevations as high as about 2,100 m and are highest known pediment deposits in quadrangle.

Qt **Terrace deposits (Holocene and late Pleistocene)** Silty sand and sandy pebble to cobble gravel in strath- or fill-terrace remnants. Locally interbedded with coarse colluvium along steep canyon walls. Present along Carson River east of Carson City (Bingler, 1977).

LACUSTRINE DEPOSITS

Qp **Playa deposits (Holocene)** Clay, silt, and very fine to fine sand of ephemeral lakes in central parts of closed basins. Surfaces are flat, mud-cracked, vegetation free, and hard. At margins grades into coarse sand and gravel of adjacent alluvial deposits. Present as a large (4 by 6 km) playa directly west of Churchill Butte and as several small circular or elliptical playas (less than 0.5 km in diameter) elsewhere in quadrangle.

Qly **Younger lacustrine deposits (Holocene and late Pleistocene)** Silt, clay, and fine sand of (1) small mountain lakes in the Carson Range, (2) near-shore areas of present-day Washoe Lake, and (3) isolated mountain lakes in the Virginia Range and Pine Nut Mountains.

Qby **Younger beach deposits of Lake Tahoe (Holocene and late Pleistocene)** Moderately sorted, coarse to gravelly arkosic sand that forms beaches and beach ridges along the present-day Lake Tahoe shoreline.

Qlo **Older lacustrine deposits of Lake Lahontan (late Pleistocene)** Clay, silt, and very fine to medium sand; laminated to thick bedded; flat lying. Local layers of subrounded to rounded granules and pebbles in sand matrix. Consists mostly of strata of the Eetza and Sehoo Alloformations (Morrison and Davis, 1984). Extensive exposures in the flat central parts of Churchill and Mason Valleys and smaller exposures (1) near the Carson River between Dayton and Fort Churchill, (2) west and northwest of Churchill Butte, and (3) northeast of Lahontan Reservoir.

Qlob **Beach and near-shore older lacustrine deposits of Lake Lahontan and Washoe Lake (late Pleistocene)** Coarse near-shore gravel and finer clay, silt, and fine sand gradational into offshore lacustrine deposits. Characteristically consists of reworked older alluvial deposits in which shorelines are evident, but does not include shoreline areas developed on bedrock. Also includes near-shore, but not shoreline, deposits of silt, clay, sand, and fine gravel. Extensively developed around the margins of the high stand of late Pleistocene Lake Lahontan in Mason and Churchill Valleys, near Lahontan Reservoir, near the Carson River from 13 km northeast of Dayton to Fort Churchill, and in valley areas west of Churchill Butte. Exposures of near-shore deposits of Pleistocene Washoe Lake are present in the southeastern part of Washoe Valley.

Qtt **Terrace deposits of Lake Tahoe (late Pleistocene)** Poorly to moderately sorted arkosic silt, sand, and gravel that forms low (5 to 8 m above present-day lake level), flat to gently sloping terraces bordering Lake Tahoe at Zephr Cove, Glenbrook Bay, and Sand Point.

SPRING DEPOSITS

QTs **Siliceous sinter of Steamboat Springs area (Holocene to Pliocene)** Deposits of white, dense, chalcedonic sinter and younger deposits of white, porous, opaline sinter (Thompson and White, 1964).

Qsa **Silt, alkali, gypsum, and calcareous deposits (Holocene and Pleistocene)** Unconsolidated, white to yellow-gray deposits of silt, alkali, and calcareous material near active or Pleistocene springs on eastern and western flanks of Pine Nut Mountains and southern flank of Flowery Range. In places, consists mostly of silt and gravel coated by calcareous material.

Qtr **Travertine (Pleistocene)** White travertine deposits near Pleistocene springs. Present near Rosetta Mine in north-central part of the quadrangle and about 4 km south-southeast of Dayton in west-central part of quadrangle.

Qgy **Gypsite and silt (Pleistocene)** Gypsite and silt of Mound House (Bingler, 1977), 7 km south of Virginia City; origin uncertain, most likely spring or groundwater deposits (Papke, 1987) downslope from nearby Jurassic gypsum and limestone (Jgl).

EOLIAN DEPOSITS

Qsd **Sand dunes (Holocene and late Pleistocene)** Unconsolidated, well sorted, fine- to medium-grained sand. Forms barchanoid ridge dunes and longitudinal dunes. Largely derived from easily eroded Pleistocene sandy lacustrine deposits. Large areas of sand dunes are within and east of Mason and Churchill Valleys in eastern part of the quadrangle. Also present as isolated elongate dunes adjacent to Carson River flood plain.

Qes **Eolian sand deposits (Holocene and late Pleistocene)** Unconsolidated, well sorted, fine- to medium-grained, subrounded to rounded sand. In most places, forms a veneer less than 0.5 m thick over Quaternary alluvial fans or lacustrine deposits. Largely derived from easily eroded Pleistocene sandy lacustrine deposits and is most common in piedmont and low mountain areas leeward (east or northeast) of such lacustrine deposits. Most widespread on east side of Carson Valley, near the Carson River 3 to 10 km northeast of Dayton, east of a playa 20 km northeast of Dayton, east of Mason Valley, east and northeast of Lahontan Reservoir, and within and east of Churchill Valley.

LANDSLIDE DEPOSITS

Qls **Landslide deposits, undivided (Holocene and Pleistocene)** Masses of unsorted, angular, boulder- to clay-sized debris. Mostly forms hummocky lobate masses in upland terrain. Includes debris-flow deposits that constitute almost all of the large (4 km long and 1 to 2 km wide) landslide deposit south and southeast of Slide Mountain west of Washoe Lake. Another large landslide deposit is present near the north end of the Pine Nut Mountains, and several other large landslides are present in the Carson Range in the northwestern part of quadrangle.

ARTIFICIAL DEPOSITS

af **Artificial fill and excavations (Holocene)** Man-made excavations and fill. Consists mostly of mine dumps and mill tailings along the southern border of the quadrangle related to an open-pit mine near Yerington (1–2 km south of the southern border of the quadrangle) and placer workings between Silver City and Dayton.

QUATERNARY AND YOUNGER TERTIARY VOLCANIC, INTRUSIVE, AND SEDIMENTARY ROCKS

QTb **Basalt (Pleistocene and Pliocene)** Lava flows of olivine basalt, basaltic andesite, and pyroxene basalt. Locally includes small cinder deposits. Isotopically dated rocks in quadrangle are 1.13 and 2.53 Ma near Steamboat Springs (Silberman and others, 1979; Bonham and Rogers, 1983), 1.17 to 1.54 Ma near McClelland Peak in Virginia Range (Silberman and McKee, 1972; Morton and others, 1980; Fultz and others, 1984), and 3.3 to 4.3 Ma on Churchill Butte (Fultz and others, 1984; Bell and others, 1984).

QTr **Rhyolite (Pleistocene and Pliocene)** Pumiceous rhyolite containing sparse phenocrysts of sanidine, quartz, sodic plagioclase, and biotite (Thompson and White, 1964). Present in Steamboat Springs area and southern part of Truckee Meadows, both about 7 km south of Reno, and in the Sutro rhyolite dome about 7 km east-northeast of Virginia City. Isotopically dated rocks in quadrangle are 1.17 to 3.11 Ma in age in the Steamboat Hills and southern part of Truckee Meadows areas (Silberman and others, 1979) and about 1.55 Ma in age in the Sutro rhyolite dome (Silberman and others, 1979).

Tad **Andesite and dacite (Pliocene and Miocene)** Andesite and dacite flows, volcanic breccia (lahar), and tuff-breccia. A thick and widespread unit containing rocks erupted from many centers, ranging in age from as old as about 20 Ma to apparently at least as young as 6 Ma and possibly to as young as 2.8 Ma. The rocks contain abundant, large (3 to 10 mm) phenocrysts of plagioclase, hornblende, pyroxene, and, locally, biotite in a fine-grained groundmass. Petrographically considered andesite and dacite. SiO_2 content ranges from 57 to 61% (Whitebread, 1976). Locally includes minor amounts of rhyolitic tuff, rhyolite, and tuffaceous sedimentary rocks. Extensively propylitically and argillically altered, and bleached in Virginia Range and locally elsewhere in quadrangle. Unit includes the Kate Peak Formation and Knickerbocker Andesite in the Virginia and Carson

Ranges (Thompson and White, 1964; Bonham, 1969; Rose, 1969; Whitebread, 1976; Bonham and Rogers, 1983; Hudson, 1993) and lithologically similar rocks in the Pine Nut Mountains, on Churchill Butte, in the Desert Mountains, and small areas elsewhere in quadrangle. Extensive K-Ar dating of the Kate Peak Formation in the Virginia City area in western part of Virginia Range yielded ages ranging from 12.6 to 15.0 Ma (Bonham, 1969; Silberman and McKee, 1972; Whitebread, 1976; Vikre and McKee, 1987). Two dates on a single sample from rocks of this unit in the Carson Range are 18.9 and 20.2 Ma (Hudson, 1983); these rocks were reported (D.M. Hudson, written commun., 1993) to be lithologically dissimilar to either the Alta Formation or the Kate Peak Formation of the Virginia Range. An 11.2-Ma age on sedimentary rocks (Tads) which are part of the andesite and dacite unit in eastern part of the Virginia Range (4 km north of the quadrangle boundary) suggests that the andesite and dacite unit in eastern part of Virginia Range is, in part at least, younger than rocks included in the unit in western part of range. Rocks included as part of the andesite and dacite unit, and veins and intrusions that cut them, in the Como area of northern Pine Nut Mountains have K-Ar ages ranging from 2.8 to 6.0 Ma (Vikre and McKee, 1994). These young ages of the unit are confirmed by a K-Ar age of 5.2 Ma from a basalt flow (Tada) enclosed within the andesite and dacite unit near the Hercules Mine about 8 km north-northeast of Como and by a K-Ar age of 6.0 Ma from a porphyritic andesite from a monolithologic breccia near Churchill Canyon about 13 km east of Como (Stewart and others, 1994). The rocks in the Como, Hercules Mine, and Churchill Canyon areas are considerably younger than any known rocks comprising the andesite and dacite unit elsewhere in quadrangle and may constitute a relatively young volcanic center. The limits of this center are unknown, but not all rocks of the andesite and dacite unit in Pine Nut Mountains are this young. An older age (15.2 Ma) was obtained on rocks of the unit about 8 km south of Como (Stewart and others, 1994). The andesite and dacite unit locally includes interlayered units of:

Tada **Andesite and basalt** A diverse assemblage of local rocks units consisting of generally fine-textured andesite, hornblende andesite, pyroxene andesite, hornblende-pyroxene andesite, and pyroxene basalt. Present in scattered outcrops extending from 1 km southeast of Dayton to alternate U.S. Highway 95 west of the Desert Mountains, and near Lahontan Reservoir. Associated with andesite and dacite (Tad) unit and, in most places, appears to be enclosed within this unit but, locally, relation to unit Tad is uncertain. Consists of local units of somewhat diverse lithology and age.

Tads **Sedimentary rocks** Tuffaceous sandstone, siltstone, claystone, diatomite, conglomerate, rhyolitic tuff, and volcanic breccia (lahar) enclosed within, or intertonguing with, andesite and dacite of Tad unit. The volcanic breccia in the unit is composed of andesite and dacite fragments derived from rocks comprising unit Tad. In part, consists of an unnamed sedimentary unit (unit Td) of Rose (1969) and assigned by him to the Desert Peak Formation, but reassigned by Bonham (1969) to the Kate Peak Formation; also includes large unnamed units enclosed within unit Tad elsewhere in quadrangle. K-Ar date of 11.2 Ma (Krebs and Bradbury, 1984) from a tuff in unit Td of Rose (1969), 4 km north of the quadrangle, but may range in age from 15 to 2.8 Ma, the possible overall span age span of unit Tad.

Tadi **Intrusive andesite and dacite** Andesite and dacite hypabyssal intrusions related to, and lithologically similar to, andesite and dacite (Tad) unit.

Ti **Intrusive rocks (Pliocene and Miocene)** Andesite, dacite, and quartz latite hypabyssal intrusions. Consists of rocks of unknown correlation affinities in Buckskin Range and near Lahontan Reservoir.

Thc **Sandstone of Hunter Creek (Miocene)** Tuffaceous sandstone, siltstone, and claystone; minor amounts of sandy conglomerate, diatomaceous shale and siltstone, and olivine basalt. Present only within and west to south of Reno. K-Ar age dates of 8.6 Ma on an olivine basalt near base of unit and of 5.9 Ma (Evernden and James, 1964, recalculated using new constants, Dalrymple, 1979) on a andesitic tuff from within unit.

Tha **Hornblende andesite (Miocene)** Hornblende andesite with phenocrysts of plagioclase and hornblende in fine-grained groundmass. Present in a west-northwest-trending belt, part of Lahontan Reservoir Structural and Volcanic Zone (John and others, 1993) in northeastern part of quadrangle. K-Ar age of 6.7 Ma (Stewart and others, 1994).

Tac **Andesite in Como area (Miocene)** Pyroxene or hornblende-pyroxene andesite flows, flow-breccia, and sparse tuff (Russell, 1981). Common propylitic alteration. One K-Ar age of 17.6 Ma and several ages ranging from 6.0 to 7.5 Ma have been determined from unit (Vikre and McKee, 1994).

Tba **Basalt, basaltic andesite, and andesite (Miocene)** Widespread lava flows of olivine, pyroxene, and olivine-pyroxene basalt and basaltic andesite and of hornblende andesite. Unit includes Lousetown Formation in Virginia Range and unnamed units elsewhere in quadrangle. Locally includes cinder deposits, basaltic tuff, possible intrusive breccia, and small intrusive masses. In the northeastern part of quadrangle, north of Lahontan Reservoir, includes several 1- to 6-km-long dike-like intrusive breccias. Isotopically dated rocks in unit range in age from 11.8 Ma about 3 km north of Silver Springs to 6.7 Ma near the Carson River 5 km west of Fort Churchill (Fultz and others, 1984).

Tgl **Glenbrook volcanic center (Miocene)** Porphyritic hornblende-sanidine latite in irregular intrusive masses and dikes, local vitric-crystal tuff, and associated hornblende trachyte flows and vent fill near Glenbrook on east shore of Lake Tahoe (Grose, 1985). K-Ar age of 8.7 Ma (Morton and others, 1977).

Tmu **Mustang Andesite (Miocene)** Hornblende andesite; large hornblende phenocrysts in fine-grained matrix (Thompson and White, 1964). Present only in the Virginia Range in northernmost part of quadrangle. K-Ar ages of 9.1 to 9.2 Ma (Morton and others, 1977, 1980) in the Virginia Range 1 to 2 km north of the quadrangle and of 8.65 Ma (Morton and others, 1980) in the Virginia Range in northernmost part of the quadrangle.

Tr **Rhyolite (Miocene)** Aphanitic to porphyritic; porphyrityic rocks have phenocryst contents varying from mostly quartz; to plagioclase, sanidine, biotite, and quartz; to plagioclase and biotite; and to plagioclase, hornblende, and biotite. Forms shallow intrusions and flows. Present at and near Washington Hill in northern Virginia Range, in a west-northwest-trending belt through Desert Mountains (part of the Desert Mountains Structural and Volcanic Zone of John and others, 1993) and in a west-northwest-trending belt near the Lahontan Reservoir (part of the Lahontan Reservoir Structural and Volcanic Zone, John and others, 1993). K-Ar ages of 11.2 Ma at Washington Hill (Silberman and others, 1979), 8.3 Ma on north flank of Desert Mountains (Stewart and others, 1994), 13.4 Ma near Lahontan Reservoir (Stewart and others, 1994), and 14.4 Ma 2 km north of Silver Springs (Stewart and others, 1994).

Ts **Sedimentary rocks (Miocene)** Tuffaceous sandstone, siltstone, claystone, conglomerate, diatomite, and rhyolitic tuff. Unit consists of rocks mapped as Coal Valley Formation by Rose (1969) in eastern part of Virginia Range, the Coal Valley Formation by Axelrod (1962) and the Truckee Formation by Thompson and White (1964) in western part of Virginia Range, and unassigned strata elsewhere in the quadrangle. K-Ar ages of 12.6 Ma in western part of Virginia Range (Silberman and McKee, 1972; same age also reported by D.I. Axelrod, written commun., 1993, from a different sample in the western part of Virginia Range) and 9.75 to 9.79 Ma (F.H. Brown, written commun., 1993) for sedimentary rocks to the north of, but continuous with, those in northeasternmost part of quadrangle. In most places, overlies andesite and dacite unit (Tad), but in some places intertongues with it. In places, may be entirely or partly continuous with sedimentary rocks unit (Tads) of andesite and dacite unit. Overlain by, or interlayered with, basalt and andesite of unit Tba.

Td **Davidson Granodiorite (Miocene)** Medium-grained equigranular diorite to biotite-hornblende granodiorite to andesite porphyry (Thompson and White, 1964; Hudson, 1993). K-Ar ages of 10.8 to 14.7 Ma (Vikre and McKee, 1987; Vikre and others, 1988) and fission track ages of 10.5 to 17.6 Ma (Vikre and others, 1988) have been determined on the Davidson Granodiorite. Vikre and others (1988) considered these dates to be related to post-intrusion heating or hydrothermal activity rather than to original intrusion or crystallization. Present in Virginia city area.

Tlf **Andesite of Lincoln Flat (Miocene)** Andesite with abundant phenocrysts of hornblende or hornblende and plagioclase; local pyroxene andesite. Consists of lava flows and tuff-breccia. Local sedimentary rocks interstratified with the andesite. Present only in Singatse Range area. K-Ar dating on a porphyritic andesite breccia gave ages of 17.4 and 19.2 Ma and on an andesite flow, 18.2 Ma (Proffett and Proffett, 1976, *recalculated using new constants*, Dalrymple, 1979). The andesite flow, redated using $^{40}Ar/^{39}Ar$ methods, gave an age of 13.83 Ma (Dilles and Gans, 1993), suggesting that the K-Ar ages of the andesite of Lincoln Flat are too old and that much of unit may be younger than 14 Ma. Locally includes:

> **Tlfi** **Intrusive rocks related to andesite of Lincoln Flat** Andesite plugs, dikes, and sills; includes minor hornblende-biotite quartz dacite porphyry. K-Ar dating on an andesite dike yielded 19.0- and 19.4-Ma ages and on a dacite intrusion yielded 14.6-, 19.0-, 19.2-Ma ages (Proffett and Proffett, 1976, recalculated using new constants, Dalrymple, 1979). The dacite intrusion, redated using $^{40}Ar/^{39}Ar$ methods, gave ages of 12.12 and 12.70 Ma (Dilles and Gans, 1993), suggesting that the K-Ar ages on these intrusive rocks are too old.

Tsta **Sedimentary rocks, tuff, and andesite (Miocene)** Siltstone, tuffaceous sandstone, fine- to coarse-grained tuff and lapilli tuff, and andesite or basalt. In most places, unit is highly silicified, adularia-rich and forms a dense silicic rock. Continuous to east with rocks mapped as Chloropagus and Desert Peak Formations by Axelrod (1956). Assigned to the Pyramid sequence by Greene and others (1991). Present in northeastern part of quadrangle, east of Lahontan Reservoir.

Tp **Pyramid sequence (Miocene)** Basalt and andesite lava flows, commonly with siliceous amygdules. These rocks were called the Chloropagus Formation by Rose (1969), but were assigned to the Pyramid sequence by Bonham (1969). In quadrangle, exposed only in eastern part of Virginia Range.

Ta **Alta Formation (Miocene)** Hornblende-pyroxene and pyroxene andesite and local soda trachyte, trachybasalt, and rhyodacite (Thompson and White, 1964; Rose, 1969; Bonham, 1969; Whitebread, 1976; Hudson, 1993). Extensive propylitic and argillic alteration. Consists of lava flows, flow-breccia, volcanic breccia (lahar), volcaniclastic sedimentary rocks, and pyroclastic rocks; includes the Sutro Member composed of tuffaceous siltstone and sandstone, and local conglomerate. In the Virginia City area, unit includes the American Ravine Andesite Porphyry (Thompson and White, 1964). Present in Steamboat Hills, Virginia Range, along and near the Carson River canyon, and Brunswick Canyon east of Carson City. K-Ar ages range from 14.8 to 20.1 Ma (Silberman and McKee, 1972; Whitebread, 1976; Vikre and McKee, 1987).

ASH-FLOW TUFFS AND RELATED FLOWS AND SEDIMENTARY ROCKS

Carson City area

Tsc **Santiago Canyon Tuff (Miocene)** Crystal-rich, strongly welded, cliff-forming ash-flow tuff; phenocrysts of quartz, sanidine, plagioclase, hornblende, biotite, and distinctive, but sparse, sphene. K-Ar ages of 21.6 to 22.8 Ma (Bingler, 1978; Bingler and others, 1978).

Tec **Eureka Canyon Tuff, dacite tuff, rhyolite tuff, and augite rhyodacite tuff, undivided (Miocene? and Oligocene)** Unit consists of the Oligocene Eureka Canyon Tuff and several overlying tuffs (Bingler, 1978). The Eureka Canyon Tuff is a poorly to moderately welded, ash-flow tuff containing 3 to 8% phenocrysts of quartz, sanidine, plagioclase, and sparse biotite. Correlated by Bingler (1978) with upper part of the Bluestone Mine Tuff (Proffett and Proffett, 1976) in the Singatse Range and with one of the thin cooling units in the tuff of Gabbs Valley 30 to 60 km southeast of quadrangle (Ekren and others, 1980). Inconsistent K-Ar ages of 17.75 Ma (Deino, 1985) and 26.1 Ma (Bingler and others, 1978). The 17.75-Ma age appears to be too young because of the correlation of the Eureka Canyon Tuff with the upper part of the Bluestone Mine Tuff which underlies the 24.2- to 24.7-Ma tuff and breccia of Gallagher Pass. Also included in unit is a dacite tuff (Bingler, 1978) that overlies the Eureka Canyon Tuff about 8 km southwest of Virginia City and a rhyolite tuff and augite rhyodacite tuff that overlie the Eureka Canyon Tuff about 15 km south of Virginia City.

Tnh **Nine Hill Tuff (Oligocene)** Crystal-poor, highly welded ash-flow tuff; phenocrysts consist of sanidine, plagioclase, and quartz; characterized by strongly flattened and stretched pumice fragments, some with length-to-thickness ratios of 20:1 (Bingler, 1978); K-Ar age of 24.29 Ma (Deino, 1985).

Tlc **Lenihan Canyon Tuff (Oligocene)** Crystal-rich, moderately to strongly welded ash-flow tuff; phenocrysts of quartz, sanidine, plagioclase, biotite, hornblende, and a trace of opaque oxides (Bingler, 1978); K-Ar ages of 25.1 to 26.7 Ma (Bingler and others, 1978).

Tmp **Mickey Pass Tuff (Oligocene)** Crystal-rich ash-flow tuff containing sanidine, plagioclase, quartz, and biotite phenocrysts; white pumice lapilli increase in amount upward to about 10% near top of unit. In Carson City area, the Mickey Pass Tuff consists entirely of rocks very similar to the lower member (Guild Mine Member) of the Mickey Pass Tuff in Singatse Range (Bingler, 1978). The upper member (Weed Heights Member) of the Mickey Pass Tuff that is present in the Singatse Range is apparently is missing in the Carson City area. A K-Ar date on a sample of the Mickey Pass Tuff collected 10 km east-northeast of Carson City gave ages of 28.0 to 28.6 Ma (Bingler and others, 1978).

Tc **Conglomerate (Oligocene and (or) older Tertiary)** Conglomerate consisting of angular to rounded pebbles to boulders of Tertiary volcanic, pre-Tertiary metavolcanic, and pre-Tertiary mafic plutonic rocks (Grose, 1986). Deposited in an east-northeast-trending paleovalley stratigraphically below Oligocene ash-flow tuffs (Grose, 1986). Equivalent to the conglomerate and breccia (Tc) unit of Grose (1986) and bouldery gravel (Tlg) assigned by Trexler (1977) to the Lenihan Canyon Tuff. In higher parts of Carson Range, also includes gravel mapped by Trexler (1977) as unit QTg.

Singatse and Buckskin Ranges and western part of Wassuk Range

Tps **Tuffs postdating the Singatse Tuff (Oligocene)** Unit consists of the Bluestone Mine Tuff (Proffett and Proffett, 1976) and overlying tuff and breccia of Gallagher Pass (Proffett and Proffett, 1976). The Bluestone Mine Tuff consists of several mineralogically distinct, crystal-poor, unwelded to poorly welded ash-flow tuffs and interbedded sedimentary rocks; it contains, in part, ash-flow tuffs correlated (Bingler, 1978; Ekren and others, 1980; Deino, 1985) with the Eureka Canyon Tuff and the Nine Hill Tuff in the Carson City area and with the tuff of Gabbs Valley in areas about 50 km southeast of the Singatse Range. The tuff and breccia of Gallagher Pass consists of crystal-rich dacite tuff-breccia, breccia, and ash-flow tuff containing phenocrysts of plagioclase, biotite, and pyroxene; it is isotopically dated as 24.2 to 24.7 Ma in age (Proffett and Proffett, 1976, recalculated using new constants, Dalrymple, 1979); it is correlative with the Hu-pwi Rhyodacite (Ekren and others, 1980; Proffett and Dilles, 1984).

Tsi **Singatse Tuff (Oligocene)** Crystal-rich, strongly to moderately welded ash-flow tuff. Phenocrysts of plagioclase, quartz, sanidine, biotite, and hornblende; sparse pumice. K-Ar dating in Singatse Range (Proffett and Proffett, 1976; recalculated using new constants, Dalrymple, 1979) gave ages of 27.9 to 32.5 Ma. The latter date is probably too old, because it overlaps the age of the well-dated underlying Mickey Pass Tuff.

Tmp **Mickey Pass Tuff (Oligocene)** Crystal-rich ash-flow tuff divided into two members, the older Guild Mine Member and the younger Weed Heights Member. The Guild Mine Member contains plagioclase, biotite, and pyroxene phenocrysts near base grading upward into sanidine, quartz, plagioclase, and biotite phenocrysts in middle and upper parts of member; strongly welded near base and unwelded at top; large white pumice in upper part. The Weed Heights Member is moderately welded, moderately crystal-rich, and contains phenocrysts of plagioclase, sanidine, quartz, and biotite, and also abundant white pumice. K-Ar dating in the Singatse Range (Proffett and Proffett, 1976; recalculated using new constants, Dalrymple, 1979) within or directly adjacent to quadrangle indicates ages of 25.8 to 28.7 Ma for the Guild Mine Member and 26.8 to 28.5 Ma for the Weed Heights Member. $^{40}Ar/^{39}Ar$ dating yielded an age of 27.02 Ma (McIntosh and others, 1992) for the undivided Mickey Pass Tuff.

Remainder of quadrangle

Ttu **Tuffs, undivided (Miocene and Oligocene)** Generally small outcrops of undivided ash-flow tuffs. Includes one large outcrop in the southern part of the Pine Nut Mountains.

GRANITIC ROCKS

Kgr **Granitic rocks, undivided (Cretaceous)** Hornblende-biotite granodiorite or granite, medium- to coarse-grained, common porphyritic phases, uncommon porphyry phases, sparse alteration. Locally includes more mafic granitoids. Age poorly known but, on the basis of scattered dates in the quadrangle and in nearby areas, most granitic rocks of this unit probably range from about 80 to 110 Ma (John and others, 1994). As mapped, unit possibly could include local, relatively small Jurassic intrusions.

KJd **Diorite and quartz diorite (Cretaceous or Jurassic)** Fine-grained, equigranular, biotite-hornblende diorite and quartz diorite. Scattered outcrops in southern and central parts of quadrangle.

Js **Shamrock batholith (Middle Jurassic)** Medium-grained hornblende or biotite-hornblende granodiorite or granite (Dilles and Wright, 1988; Proffett and Dilles, 1984; John and others, 1994) in Pine Nut Mountains in southern part of quadrangle. Sparse quartz porphyry and aplite dikes. Locally strong sodic-calcic alteration. A U-Pb age of 165.8 Ma (Dilles and Wright, 1988). Includes the quartz monzonite of Mt. Siegel (Stewart and Noble, 1979).

Jib **Iron Blossom pluton (Middle Jurassic)** Medium-grained, seriate biotite-hornblende granodiorite that contains about 20% mafic minerals composed dominantly of hornblende (John and others, 1994). Present along U.S. Highway 50, 14 km northeast of Dayton and in adjacent parts of Flowery Range. Undated isotopically, but inferred to be Middle Jurassic by John and others (1994) because of its mineralogical and chemical similarity to dated Middle Jurassic plutons in central-western Nevada and its apparent genetic relation to iron-skarn mineralization that, elsewhere in central-western Nevada, is associated with Middle Jurassic plutons.

Jd **Diorite and quartz diorite (Middle Jurassic)** Fine-grained, equigranular, hypidiomorphic rocks with 25 to 35% mafic minerals of hornblende and sparse clinopyroxene and biotite (John and others, 1994). Large bodies in an area centered about 8 km south southwest of Virginia City and in an area about

18 km northeast of Dayton along and near the southern part of the Flowery Range. Undated isotopically, but considered to be Middle Jurassic because of close spatial association with Middle Jurassic volcanic rocks, chemical composition, and types of associated hydrothermal alteration (John and others, in 1994).

Jp **Quartz monzodiorite porphyry (Middle Jurassic)** Coarsely crystalline phases of unit contain 40 to 50% phenocrysts, mostly of plagioclase which forms tabular crystals as much as 1.5 cm long and less abundant hornblende, biotite, resorbed quartz, and large megacrysts of potassium feldspar set in a microcrystalline matrix of the same minerals (Castor, 1972; John and others, 1994). Fine crystalline phases of unit contain the same minerals, but phenocrysts are 1 to 3 mm, except for rare 1-cm potassium feldspar (Proffett and Dilles, 1984). Present in Singatse and Buckskin Ranges and the Pine Nut Mountains. Includes the granodiorite prophyry of Castor (1972) and Proffett and Dilles (1984) and the quartz monzodiorite porphyry of Dilles and Wright (1988). Intrudes the Fulstone Spring Volcanics and all older rock units, and in Singatse Range south of the map area is inferred to predate the Shamrock batholith (Proffett and Dilles, 1984; Dilles and Wright, 1988). A minimum U-Pb age of 165 Ma was obtained by Dilles and Wright (1988). Present as dikes and sills, and locally more massive bodies. In the quadrangle, in Singatse Range south of the quadrangle, and in the Wassuk Range about 30 km east of the quadrangle, commonly intruded along major east-west, graben-forming faults that bound a downdropped structural block that contains the Yerington batholith and older rocks (Dilles and Wright, 1988).

Jy **Yerington batholith (Middle Jurassic)** A compositionally diverse batholith ranging from fine-grained biotite-hornblende quartz monzodiorite to medium-grained hornblende-biotite granite; also includes cumulate gabbros, aplite and pegmatite dikes, and granite prophyry (Dilles, 1987; Dilles and Wright, 1988; Proffett and Dilles, 1984; John and others, 1994). Consists of three major intrusive phases, which successively decrease in volume, silica content, and depth of emplacement. These successive intrusive phases consist primarily of quartz monzodiorite, quartz monzonite, and granite, respectively. The granite grades into granite porphyry dikes that are temporally and spatially associated with porphyry copper mineralization. The three intrusive phases of the batholith are considered a comagmatic suite and U-Pb age indicates emplacement of the three phases from 168.5 to 169.4 Ma (Dilles and Wright, 1988).

Jsp **Sunrise Pass pluton (Middle Jurassic)** Biotite-hornblende granodiorite and granite in two textural phases—a medium-grained, equigranular phase and a medium- to coarse-grained, coarsely porphyritic phase that contains 10 to 20 percent white to pink potassium feldspar megacrysts as long as 3 cm (Castor, 1972; John and others, 1994). Both textural phases generally contain 5 to 10% hornblende and only minor biotite. A discordant U-Pb date suggests an approximate emplacement age of 172 ± 5 Ma (Dilles and Wright, 1988).

SEDIMENTARY AND VOLCANIC ROCKS

Jv **Volcanic and metavolcanic rocks (Middle Jurassic)** Unit consists of the Fulstone Spring Volcanics in Buckskin Range and unnamed metavolcanic rocks in hills in Carson Valley, in Pine Nut Mountains and Virginia Range, and at Churchill Butte. The Fulstone Spring Volcanics, which overlie the Artesia Lake Volcanics (Jal), consists of latite, quartz latite, and dacite porphyry domes, breccias, and flows and lesser amounts of latite ash-flow tuff, andesite, and conglomerate (Dilles and Wright, 1988; Proffett and Dilles, 1996). A U-Pb age of 166.5 Ma has been obtained on a sample of quartz latite porphyry from the Fulstone Spring Volcanics. The Fulstone Spring Volcanics may be cogenetic with the Shamrock batholith (165.8 Ma)(Dilles and Wright, 1988). In other parts of the quadrangle, rocks included in unit Jv consist of andesite and dacite lava flows, breccias, and hypabyssal intrusions. These rocks are poorly dated and may include rocks lithologically or temporally equivalent to Artesia Lake Volcanics as well as to the Fulstone Spring Volcanics. Metamorphism of rocks of unit Jv is generally of greenschist grade.

Mzvs **Volcanic and sedimentary rocks, undivided (Mesozoic)** Volcanic and sedimentary rocks, generally metamorphosed, in Carson Range and in hills in Carson Valley. Consist of pyroclastic breccias, flow breccias, and lava flows of intermediate to mafic composition; interstratified with quartzite, sandstone, and volcanic conglomerate. Undated.

Mzfs **Felsic schist and related rocks (Mesozoic)** Fine-grained flaser schist and banded flaser gneiss. Present on east side of Carson Range and in hills in Carson Valley. Includes unit TRfs of Pease (1980), Trexler (1977), and Bingler (1977). Also includes andalusite phyllite and slate in the New Empire and Carson City 7½' Quadrangles (unit Jp of Trexler, 1977, and Bingler, 1977). Undated.

Jal **Artesia Lake Volcanics (Early Jurassic)** Andesite and dacite lava flows and breccias, minor silicic pyroclastic rocks, volcaniclastic sedimentary rocks, and small shallow-level intrusions (Hudson and Oriel, 1979; Proffett and Dilles, 1984; Dilles and Wright, 1988, Proffett and Dilles, 1996). Recognized only in Buckskin and Singatse Ranges. Considered by Dilles and Wright (1988) to be comagmatic with the Yerington batholith (168.5 to 169.4 Ma).

Jgl **Gypsum and limestone (Early Jurassic)** Coarse-grained gypsum and medium-grained limestone (or marble). Forms one small outcrop in Virginia Range, 6 km south-southwest of Virginia City. Considered to be Early Jurassic in age because gypsum in pre-Tertiary rocks elsewhere in western Nevada are known, or considered, to be of this age (Papke, 1987; Stewart, 1997).

JŦRg **Gardnerville Formation and related rocks, undivided (Early Jurassic and Late Triassic)** Mostly siltstone or argillite; generally calcareous and carbonaceous. Includes minor amounts of sandstone, limestone and silty limestone, volcaniclastic conglomerate, and metamorphosed tuff. Crops out near Steamboat Springs, in the Virginia Range and Buckskin Ranges, in the Pine Nut Mountains, at Churchill Butte, and questionably in the Thompson Smelter area (5 km northwest of Wabuska in northern Mason Valley). Unit is paleontologically dated as late Norian (latest Late Triassic) to late Toarcian (late Early Jurassic) in age (Stewart, 1997).

ŦRls **Limestone and siltstone (Late Triassic)** Mostly limestone (or marble), siltstone, and hornfels and variable amounts of metamorphosed silicic to intermediate tuff and lithic-tuff breccia. Crops out in the Pine Nut Mountains (Bingler, 1977), in the Buckskin Range (Proffett and Dilles, 1996), near Thompson Smelter (5 km northwest of Wabuska in northern Mason Valley) (Stewart, 1997), and in hills in eastern part of Mason Valley (Stewart, 1997). In the Pine Nut Mountains, these rocks are assigned by Stewart (1997) to the Oreana Peak Formation, which was originally described by Noble (1962, 1963) in the southern part of the Pine Nut Mountains, 18 km south of the quadrangle. Four to 6 km south of the quadrangle in the Singatse Range, a well exposed section of rocks correlative with these rocks has been divided, from bottom to top, into the Malachite Mine Formation, tuff of Western Nevada Mine, and Mason Valley Limestone (Proffett and Dilles, 1996). Within the quadrangle, rocks questionably assigned to either the Malachite Mine Formation or the tuff of Western Nevada Mine are recognized in Buckskin Range (Proffett and Dilles, 1996) and in outcrops in hills in eastern part of Mason Valley. Within the quadrangle, the Mason Valley Limestone is recognized in the Buckskin Range (Proffett and Dilles, 1996), questionably at the Thompson Smelter locality (Stewart, 1997), and possibly in the hills in eastern part of Mason Valley. Paleontologically dated rocks in the unit indicate a late Karnian and Norian (Late Triassic) age (Stewart, 1997).

ŦRv **Volcanic rocks (Late, Middle, and Early Triassic)** Consists mostly of andesite breccias and lava flows. Locally contains andesitic sandstone, and rhyolite, quartz latite, and latite hypabyssal intrusions, domes, lava flows, and welded tuff. Rocks are generally metamorphosed to greenschist grade. Crops out in the Pine Nut Mountains (Bingler, 1977) in western part of the quadrangle and in a northwest-trending band on the east and north sides of Mason Valley and in southern part of Desert Mountains in eastern part of quadrangle. In the Pine Nut Mountains these rocks were referred to as the metavolcanics of Brunswick Canyon by Bingler (1977) and assigned to the Middle Triassic or older McConnell Canyon Volcanics by Stewart (1996). Elsewhere in the quadrangle the rocks of the unit may also be lithologically and stratigraphically equivalent to the McConnell Canyon Volcanics. The McConnell Canyon Volcanics were named for outcrops in the Singatse Range about 6 km south of quadrangle (Proffett and Dilles, 1984; Dilles and Wright, 1988; Proffett and Dilles, 1996). Unit yielded a U-Pb age on zircon of 242 Ma (late Early Triassic) near Mt. Grant in the Wassuk Range 50 km southeast of quadrangle (Unruh and Schweickert, 1996), and quartz prophyry dikes about 6 km south of the quadrangle, which could be comagmatic with the McConnell Canyon Volcanics, have been dated as 232 Ma (Middle Triassic) by the U-Pb method on zircon (Dilles and Wright, 1988). In the Singatse Range 6 km south of the quadrangle, underlies paleontologically dated Upper Triassic (late Karnian) limestone and siltstone (Proffett and Dilles, 1984; Dilles and Wright, 1988; Proffett and Dilles, 1996). Overall unit age is late Early, Middle, and early Late Triassic.

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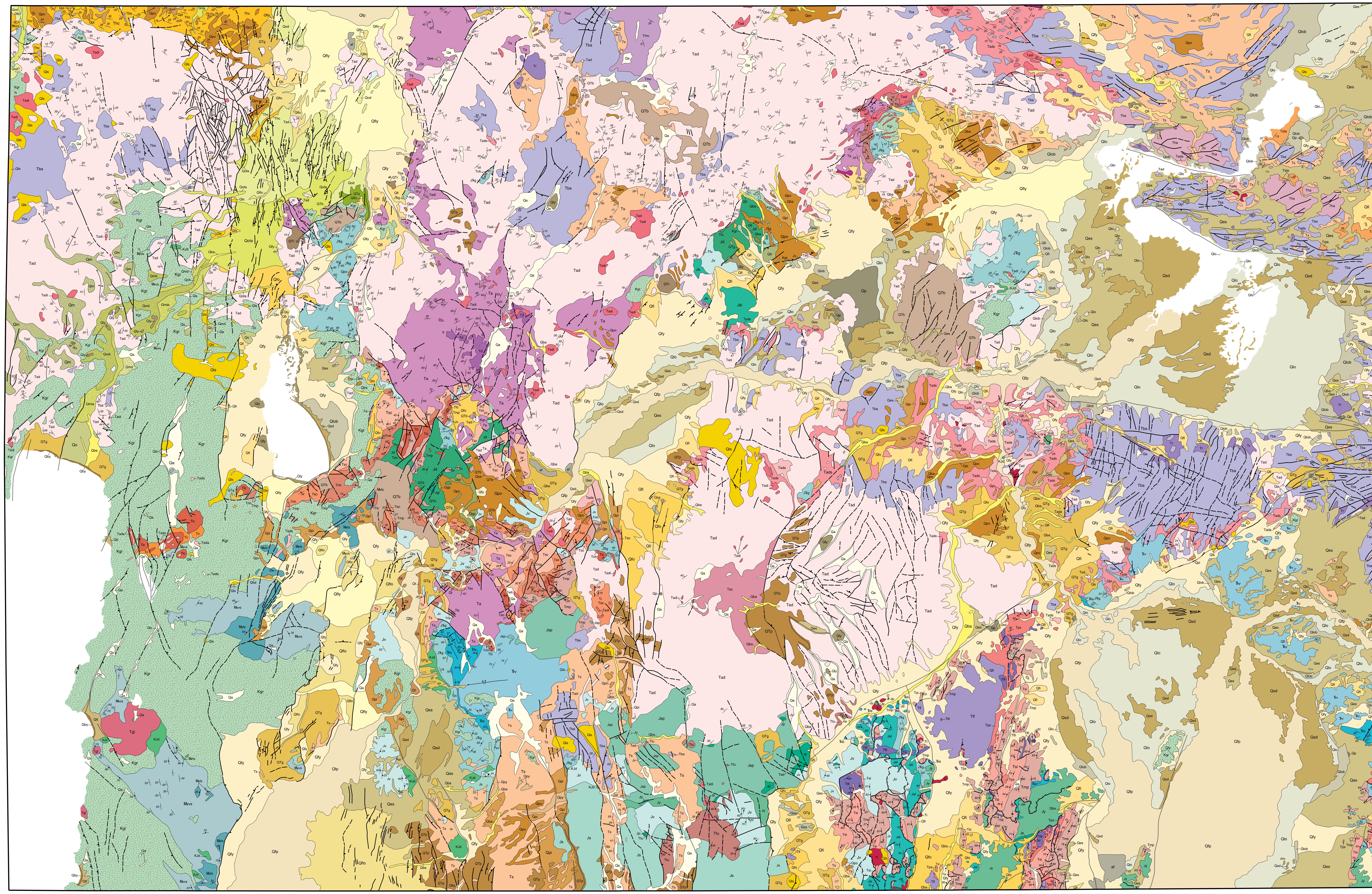


GLACIAL DEPOSITS

Qm	Morainal deposits, undivided
Qmti	Moraines of Tioga glaciation
Qmta	Moraines of Tahoe glaciation
Qmd	Moraines of Donner Lake glaciation
Qo	Outwash deposits, undivided
Qoti	Outwash deposits of Tioga glaciation
Qota	Outwash deposits of Tahoe glaciation
Qod	Outwash deposits of Donner Lake glaciation

ALLUVIAL DEPOSITS

Qa	Alluvium in small mountain valleys
Qfly	Younger fluvial deposits
Qflo	Older fluvial deposits
Qfp	Flood-plain alluvium
Qba	Braided alluvial deposits in mountain canyons
Qfy	Younger alluvial-fan deposits
Qfi	Intermediate alluvial-fan deposits
Qfo	Older alluvial-fan deposits
QTg	Gravel and sand
Qpy	Younger pediment deposits
Qpi	Intermediate pediment deposits
Qpo	Older pediment deposits
QTp	Pediment deposits
Qt	Terrace deposits

LACUSTRINE DEPOSITS

Qp	Playa deposits
Qly	Younger lacustrine deposits
Qby	Younger beach deposits of Lake Tahoe
Qlo	Older lacustrine deposits of Lake Lahontan
Qlob	Beach and near-shore older lacustrine deposits of Lake Lahontan and Washoe Lake
Qtt	Terrace deposits of Lake Tahoe

SPRING DEPOSITS

QTs	Siliceous sinter of Steamboat Springs area
Qsa	Silt, alkali, gypsum, and calcareous deposits
Qtr	Travertine
Qgy	Gypsite and silt

EOLIAN DEPOSITS

Qsd	Sand dunes
Qes	Eolian sand deposits

LANDSLIDE DEPOSITS

Qls	Landslide deposits, undivided

ARTIFICIAL DEPOSITS

af	Artificial fill and excavations

QUATERNARY AND YOUNGER TERTIARY VOLCANIC, INTRUSIVE, AND SEDIMENTARY ROCKS

QTb	Basalt
QTr	Rhyolite
Tad	Andesite and dacite
Tada	Andesite and basalt
Tads	Sedimentary rocks
Tadi	Intrusive andesite and dacite
Ti	Intrusive rocks
Thc	Sandstone of Hunter Creek
Tha	Hornblende andesite
Tac	Andesite in Como area
Tba	Basalt, basaltic andesite, and andesite
Tgl	Glenbrook volcanic center
Tmu	Mustang Andesite
Tr	Rhyolite
Ts	Sedimentary rocks
Td	Davidson Granodiorite
Tlf	Andesite of Lincoln Flat
Tlfi	Intrusive rocks related to andesite at Lincoln Flat
Tsta	Sedimentary rocks, tuff, and andesite
Tp	Pyramid sequence
Ta	Alta Formation

ASH-FLOW TUFFS AND RELATED FLOWS AND SEDIMENTARY ROCKS

Carson City Area

Tsc	Santiago Canyon Tuff
Tec	Eureka Canyon Tuff, dacite tuff, rhyolite tuff, and augite rhyodacite tuff, undivided
Tnh	Nine Hill Tuff
Tlc	Lenihan Canyon Tuff
Tmp	Mickey Pass Tuff
Tc	Conglomerate

Singatse and Buckskin Ranges and Western Part of Wassuk Range

Tps	Tuffs postdating the Singatse Tuff
Tsi	Singatse Tuff
Tmp	Mickey Pass Tuff

Remainder of Quadrangle

Ttu	Tuffs, undivided

GRANITIC ROCKS

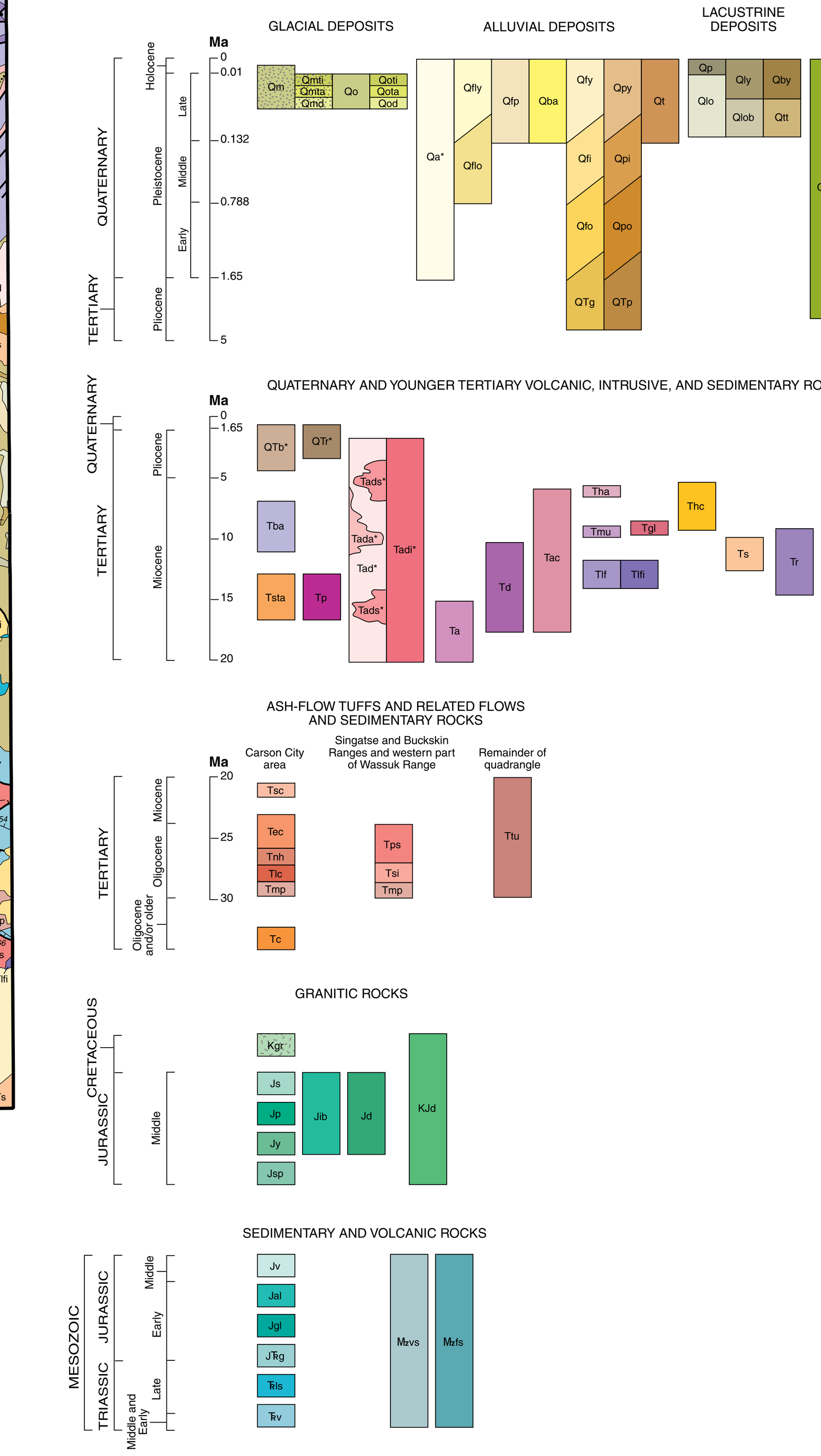
Kgr	Granitic rocks, undivided
KJd	Diorite and quartz diorite
Js	Shamrock batholith
Jib	Iron Blossom pluton
Jd	Diorite and quartz diorite
Jp	Quartz monzodiorite porphyry
Jy	Yerington batholith
Jsp	Sunrise Pass pluton

SEDIMENTARY AND VOLCANIC ROCKS

Jv	Volcanic and metavolcanic rocks
Mzvs	Volcanic and sedimentary rocks, undivided
Mzfs	Felsic schist and related rocks
Jal	Artesia Lake Volcanics
Jgl	Gypsum and limestone
JTRg	Gardnerville Formation and related rocks, undivided
TRls	Limestone and siltstone
TRv	Volcanic rocks

See accompanying booklet for map unit descriptions and references.

CORRELATION OF MAP UNITS



*See description of map units for specific unit age assignment.

Contact

High-angle normal fault Dashed where inferred or approximately located; dotted where concealed; ball on downthrown side.

Low-angle normal fault Dashed where inferred or approximately located; dotted where concealed; hachures on upper plate.

Fold axis Showing direction of plunge; dashed where inferred or approximately located.

Anticline — Overturned anticline

Syncline — Overturned syncline

Strike and dip of beds

50 Inclined — 45 Overturned — Vertical

Strike and dip of compaction foliation in ash-flow tuffs, and metamorphic foliation

53 Inclined — 85 Overturned — Vertical

Strike and dip of flow banding

30 Inclined

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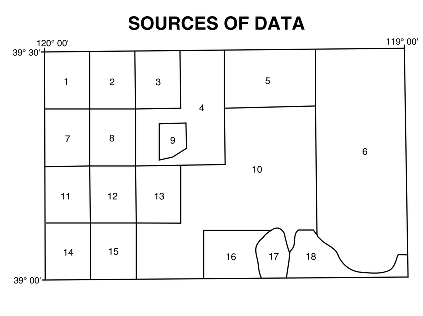
SOURCES OF DATA



Index to Sources of Data

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Scale 1:100,000

0 1 2 3 4 5 6 7 8 9 10 kilometers

0 1 2 3 4 5 miles

Contour interval 50 meters
Supplementary contour interval 10 meters
Base map: U. S. Geological Survey Carson City 30 x 60 Minute Quadrangle, 1979

GEOLOGIC MAP OF THE CARSON CITY 30 X 60 MINUTE QUADRANGLE, NEVADA

JOHN H. STEWART

1999