Text and references accompanying Nevada Bureau of Mines and Geology Open-File Report 17-5

Preliminary Geologic Map of the Boulder City NW Quadrangle, Clark County, Nevada

by

Nicholas H. Hinz[1], Seth Dee[1], and Racheal Johnsen[2]

[1]Nevada Bureau of Mines and Geology, University of Nevada, Reno
[2]Department of Geoscience, University of Nevada, Las Vegas

2017

Disclaimer: NBMG open-file reports are preliminary. They have not been thoroughly edited or peer reviewed. This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program under STATEMAP award number G16AC00186, 2017.

DESCRIPTION OF MAP UNITS

Anthropogenic Features and Deposits

Qx Anthropogenic modifications (Anthropocene) Areas of extensive anthropogenic disturbance and modification, including urban development and major transportation corridors. The geology in areas with current (2017) development was mapped using 1990 and 1994 Google Earth historical imagery. Areas mapped as Qx pre-date 1990–1994.

Quaternary Deposits

Age estimates shown are based on the criteria described in House et al. (2010) for mapping geomorphic surfaces and related sedimentary deposits in the Ivanpah Valley area.

Qc Colluvium (Holocene) Unconsolidated, angular to slightly rounded boulders to pebbles of bedrock in a variably sandy matrix.

Qp Playa deposits (Holocene) Fine-grained deposit in the Eldorado Valley dry lake bed; typically light-gray to light-brown silt, clay and minor fine sand deposited during seasonal inundation of the playa with shallow standing water. Sediments include evaporitic deposits and efflorescent salt crusts. Surface is very flat and includes local mud cracks and desiccation features. Interfingered with, and locally overlain by distal Qfy fan deposits.

Qa Young alluvium (Historic to late Holocene) Coarse-grained alluvial deposits in active axial washes; typically sandy with pebble- to cobble-sized gravel. Fresh bar-and-channel morphology with minimal soil development.

Qfy Young alluvial-fan deposits, undivided (late Holocene to late Pleistocene) Coarse-grained alluvial deposits in intermittently active alluvial fans; typically sandy pebble- to cobble-sized gravel with boulders. Clasts are subrounded to subangular. Surfaces have complex distributary flow patterns with morphology ranging from fresh bar-and-channel forms to slightly smoothed surfaces. Typically has weak to no soil development. If present, soil development is characterized by Stage I, $CaCO_3$ coatings on bottoms of clasts. Exposed thickness of the unit is typically 1–4 m.

Qfy_1 Youngest alluvial-fan deposits (late to middle Holocene) Coarse-grained alluvial deposits in intermittently active alluvial fans; typically sandy pebble- to cobble-sized gravel with boulders. Clasts are subrounded to subangular. Surfaces have complex distributary flow patterns with fresh bar-and-channel forms. Typically has weak to no soil development. If present, soil development is characterized by thin, Stage I, $CaCO_3$ coatings on bottoms of clasts. Exposed thickness of the unit is typically 1–3 m.

Qfy_2 Young alluvial-fan deposits (early Holocene to late Pleistocene) Coarse-grained alluvial deposits in generally inactive alluvial fans; typically sandy pebble- to cobble-sized gravel with boulders. Clasts are subrounded to subangular. Surface morphology ranges from subdued bar-and-channel forms to slightly smoothed surfaces with moderately-developed gravel pavement and light rock varnish on volcanic clasts. Forms terraces 0.25–2 m above active washes and Qfy_1 fans. Typical soils have cambic to juvenile argillic development with thin stage I–I+ $CaCO_3$ coatings on clasts. Fans surrounding Black Hill with primarily granitic clasts have generally less developed

$CaCO_3$ coatings. Exposed thickness of the unit is typically 1–4 m.

Qfi Intermediate-aged alluvial-fan deposits (late to middle Pleistocene) Coarse-grained alluvial deposits in mostly inactive alluvial fans; typically sandy pebble- to cobble-sized gravel, and local boulders. Clasts are subrounded to subangular. Surface morphology is planar with strongly developed, tightly packed gravel pavement and dark to very dark varnish on volcanic clasts. Incised drainages have a tributary pattern with channel incision ranging from 1–4 m. Argillic soil horizons typically erosionally stripped, with stage II–III $CaCO_3$ horizons up to 1.5 m thick. Fans surrounding Black Hill with primarily granitic clasts have generally less developed $CaCO_3$ coatings, highly desegregated granite clasts and very little preserved rock varnish. Exposed thickness of the unit rarely exceeds 5 m. Qfi is faulted by the Black Hill fault along the eastern side of Black Hill. Fossett (2005) dated inorganic, pedogenic carbonate from soils in Qfi collected from a plaeoseismic trench excavated across the Black Hill fault scarp. The samples ranged in age from 10,580 to 23,540 calibrated years before present (Fossett, 2005).

Qfie Intermediate-aged alluvial-fan deposits with eolian cap (late to middle Pleistocene) Similar morphology and characteristics as inactive Qfi fans but with a 2+ m thick cap of windblown sand and minor silt. Locally incised by active channels up to 2 m deep.

Qfo Older alluvial-fan deposits (middle to early Pleistocene) Coarse-grained alluvial deposits; typically sandy pebble- to cobble-sized gravel with boulders. Clasts are subrounded to subangular. Surface morphology ranges from planar to fully rounded erosional remnants. Planar surfaces have tightly packed gravel pavement, very dark varnish on volcanic clasts, and abundant surface litter of pedogenic carbonate. Surfaces are highly dissected by 2–4 m deep tributary channels. Upper soil horizons erosionally stripped, Stage III–IV $CaCO_3$ horizons up to 2.5 m thick form a continuous carbonate rich layer with local development of laminar carbonate structure. The oldest Qfo fans are located along the western edge of the quadrangle and are sourced from the east side of the McCullough Range. Qfo surfaces are not preserved at the surface along the east side of Black Hill, but buried stage III–IV $CaCo_3$ horizons were locally identified beneath Qfi fan deposits. Exposed thickness of the unit ranges from 5 to ~10 m.

Tertiary Volcanic and Sedimentary Rocks

Ts Tertiary sediments (Pliocene? to middle Miocene) Tan to brownish gray sandstone, pebble conglomerate, and breccia with local interbedded thin non-welded tuffs, and reworked tuffs. Clasts are subrounded to subangular with variable lithologies sourced from proximal bedrock units. Unit is primarily comprised of alluvial fan and fluvial deposits. This unit is interlayered within the upper part of the Dutchman Pass volcanics and is also interbedded with the Mount Davis Volcanics. Locally, this unit fills a depocenter in northern Eldorado Valley where the thickness may exceed 1.5 to 2 km thick based on gravity modeling (Langenheim et al., 2010). The lowermost exposed sections of Ts are dominated by volcanic clasts, whereas the uppermost sections of Ts are dominated by Trp granite clasts. The exposed bedding in Ts is concordant with the underlying volcanics in all areas except north of Railroad Pass where Ts rests along an angular unconformity with Td. Based on this pattern, the basal parts of Ts may pre-date onset of major extension in the Dutchman Pass area. In contrast, Tds exposed in the eastern part of the Boulder City NW quadrangle and in the Boulder City quadrangle (Dee et al., 2016) was deposited syntectonically along an angular unconformity with underlying strata. Although Tds and Ts have different contact patterns with the underlying volcanic rocks, Ts probably correlates in part with Tds. Thickness of Ts reaches upwards of 750 m based on cross sections.

Mount Davis Volcanics (middle Miocene)

Tdmb Middle basalt lavas of Mount Davis (middle Miocene) Dark gray to black, commonly vesicular, aphanitic to porphyritic basalt lavas. Porphyritic lavas contain plagioclase, pyroxene, and olivine. Tdmb is only exposed along the southwest edge of the River Mountains in the NE corner of this quadrangle and rests on Trm and is interlayered with Tds and Tdmh. In the adjacent Boulder City quadrangle, Tdmb is relatively widespread, and one age date of 13.27±0.03 Ma has been previously obtained in that area (Felger et al., 2014). Previous geochronologic studies outside of this quadrangle have distinguished a lower part of Tdmb with an age range of 14.2 to 14.1 Ma and an upper part with an age range of 13.77 to 13.27 Ma (Gans and Bohrson, 1998; Faulds et al., 1999). Based on contact relationships with Tdmr, the Tdmb in the Boulder City and Boulder City NW quadrangles is probably entirely the upper part. SiO_2 content ranges from 44.6–50.6 wt.% based on six analyses from samples in the Boulder City quadrangle (Dee et al., 2016). Thickness in the Boulder City NW quadrangle ranges from 10 to 80 m thick.

Tdmh Middle hornblende dacite lavas of Mount Davis(?) (middle Miocene) Light gray to tan-brown, flow-foliated, hornblende-plagioclase-biotite dacite. Tdmh is exposed in two small outcrops along the southwest edge of the River Mountains in the northeast corner of this quadrangle. One Tdmh outcrop rests on Trm and under Tds, the second outcrop is interlayered in Tdmb. Tdmh is more finely porphyritic then the overlying Tdmd that is exposed in the Boulder City quadrangle. Tdmh may be correlative or related to the middle rhyolite lavas of Mount Davis (Tdmr) that are exposed in the Eldorado Mountains in the Boulder City quadrangle (Dee et al., 2016). Alternatively, Tdmh lavas may correlate with

the Bootleg Wash dacite (Tbd) exposed in the River Mountains, also in the Boulder City quadrangle (Dee et al., 2016). SiO_2 content ranges from 62.9–65.5 wt.% based on two analyses from samples in the Boulder City quadrangle (Dee et al., 2016). Age is unknown, but may correlate with the 14.1 Ma Tdmr. Thickness in the Boulder City NW quadrangle 10 to 15 m thick.

Powerline Road volcanics (middle Miocene)

Age is 13.5 to 13.4 Ma based on one new U/Pb date in this study and one previous date (Dee et al., 2016), and represents part of the lowest part of the Powerline Road volcanics which are centered in the Henderson quadrangle to the north, as originally defined by Bell et al. (1980).

Tpd Dacite lavas (middle Miocene) Medium-light gray to pinkish, abundantly porphyritic, locally flow-banded dacite lavas. Some flows contain numerous andesite enclaves. Td is interlayered with Tpbr and Tpa in the River Mountains. This unite represents 25 to 225 m thick.

Tpbr Dacitic tuffs and volcaniclastic sediments (middle Miocene) Light gray, abundantly porphyritic, dacite tuff breccia and tuffaceous sediments interlayered with Tpd and Tpa in the River Mountains. 25 to 225 m thick.

Tpa Finely porphyritic andesite lavas (middle Miocene) Medium gray plagioclase-pyroxene porphyry andesite lavas interlayered with Tpd and Tpbr in the River Mountains. 25 to 100 m thick.

Tppa Coarsely porphyritic andesite lavas (middle Miocene) Medium to dark gray, porphyritic andesite lavas and breccia exposed in the northeast part of the quadrangle. Up to 100 m thick.

Dutchman Pass volcanics (middle Miocene)

The Dutchman Pass volcanics are part of the McCullough stratovolcano (Smith et al., 2010) and previously mapped and described as the Farmer Canyon volcanic section by Boland (1996). Five new U/Pb age dates were acquired in this study on this unit and established an age range of 15.0 to 13.9 Ma.

Tdpba Dutchman Pass basaltic andesite (middle Miocene) Medium-dark gray, plagioclase-pyroxene-olivine porphyry basaltic andesite lavas locally interlayered in the upper part of Tdpa and the lower part of Tdps. Up to about 300 m thick.

Tdpd Dutchman Pass dacite (middle Miocene) Medium-light tan-brown, plagioclase-biotite-hornblende porphyry lavas interlayered in the upper part of Tdpa and the lower part of Tdps, locally directly underlies Tdpba. Basal dark gray to black vitrophyres present locally along the base of flows. Up to about 200 m thick.

Tdptb Dutchman Pass dacite tuff breccia and sediments (middle Miocene) Light tan-brown, plagioclase-biotite-hornblende porphyry dacite tuff breccia and tuffaceous sediments interlayered in Tdpa. Up to about 100 m thick.

Tdpa Dutchman Pass andesite (middle Miocene) Medium-light to medium gray, medium brown, light-tan brown, aphanitic and plagioclase-pyroxene porphyry andesite lava and breccia. The upper part of Tdpa is interlayered with Tdpba and Tdps. Tdpd and Tdptb are locally lumped with Tdpba and are interlayered throughout Tdpa. Tdpa is intruded by Tdpai, Tdphai, Tdpdi, Tdpari, and Trp. Thickness reaches as much as 1 km based on cross sections B–B', C–C', and D–D'. Most of the lower parts of Tdpa near the intrusive contact with Trp is porpylitically altered. Upper and middle parts of Tdpa are locally argillically altered as shown by the stipple pattern on the map.

Red Mountain volcanics (middle Miocene)

Trm Red Mountain volcanics (middle Miocene) A dominantly andesite(?) composition complex of lavas, volcaniclastic sediments, and hypabyssal intrusions. Generally steeply north dipping, but attitudes are scarce due to alteration and the high volume of intrusive rocks. Total thickness is unknown. All Trm exposures are hydrothermally altered. No age dates have been obtained on the Red Mountain volcanics. Based on contact patterns with other units, Trm is probably the oldest exposed unit in the River Mountains and may represent an early volcanic pile erupted from the volcanic systems associated with the Boulder City or Railroad Pass plutons, or may correlate with the 15.5 to 15.2 Ma middle Patsy Mine volcanics, or the ~18.5–16 Ma lower Patsy Mine volcanics (Gans and Bohrson, 1998; Faulds et al., 1999; Felger et al., 2014).

Tertiary Intrusive Rocks

Dutchman Pass volcanics (middle Miocene)

Tdpdi Dutchman Pass dacite dikes (middle Miocene) Light gray plagioclase-biotite porphyry dacite dikes intruding Tdpa, Tdphai, and Trp. Tdpdi dikes are sparse relative to the abundant Tdpai dikes.

Tdpai Dutchman Pass andesite dikes and intrusions (middle Miocene) Medium to medium-dark gray aphanitic to finely porphyritic plagioclase-pyroxene andesite dikes intruding Tdpa, Tdparpi, Tdphai, and Trp. Tdpai dikes form two primary swarms, one south of Trp, and the second along the western edge of the pluton. The southern Tdpai dike swarm strikes dominantly N-S,

whereas the western dike swarm includes NW-, N-, and NE-striking dikes. Most Tdpai dikes are steeply dipping.

Tdphai Dutchman Pass hypabyssal hornblende andesite (middle Miocene) Light gray plagioclase-hornblende porphyry andesite exposed along the western margin of the quadrangle. Tdphai intrudes Tdpa and is intruded by numerous Tdpai dikes. One new U/Pb age was obtained on Tdphai in this quadrangle, 14.7 Ma.

Tdpahi Dutchman Pass hypabyssal pyroxene andesite (middle Miocene) This complex intrusive unit consist mostly of aphanitic andesite intrusions with lesser pyroxene-plagioclase porphyry andesite intrusions, and mafic-phase Trp dikes and small bodies adjacent to the primary Trp unit. Tdparpi is mostly propylitically altered throughout. Tdpahi intrudes Tdpa and is intruded by Trp. The contact between Tdpahi and Trp is sharp and mostly dips moderately to steeply west with up to 10s of meters of relief.

Unnamed volcanics of the southwest River Mountains (middle Miocene)

Tdi Dacite dikes (middle Miocene) This unit consists of a single NW-striking, steeply dipping medium tan-brown to medium-light gray, plagioclase-biotite porphyry dacite dike in the westernmost River Mountains that intrudes Trm and may correlate with Td lavas.

Tai Aphanitic andesite dikes (middle Miocene) Medium to medium-dark gray, aphanitic to sparsely porphyritic andesite dikes that intrude Trm in the River Mountains. Tpai dikes consistently intrude Tai dikes. Similar in orientation to Tpai dikes, Tai dikes are also steeply north or south dipping and strike E-W to ENE-WSW.

Tpai Porphyritic andesite dikes (middle Miocene) Medium-light to medium gray, porphyritic andesite dikes that contain ~20–25% phenocrysts of feldspar (15–20%, 1–3 mm), hornblende (2–4%, 2–3mm), and pyroxene (1–3%, 1–2 mm). Intrudes Tbc, Trm, and Tai in the River Mountains, but not the younger unnamed volcanics of the southwest River Mountains (Td, Ttb, Ta, and Tpa). Based on phenocryst assemblage, Tpai dikes may correlate with Tpa lavas which rest locally at the base of the section of younger volcanics in the southwest River Mountains. Tpai dikes dip steeply and strike consistently ENE-WSW to E-W.

Tertiary Plutonic Rocks

Boulder City pluton (middle Miocene)

Tbc Boulder City pluton, main phases (middle Miocene) Medium gray, fine-grained, equigranular granite phase of the Boulder City pluton exposed along the south flank of the River Mountains, on both the Boulder City NW quadrangle and on the Boulder City quadrangle (Dee et al., 2016). Dominantly composed of orthoclase, plagioclase, quartz, and hornblende with minor fine-grained biotite. Intrudes Trm and is intruded by Tpai dikes. Outcrops typically weather in low relief relative to the surrounding altered volcanics. The age of the Boulder City pluton spans ~14.5 to 13.5 Ma (Felger et al., 2014; Dee et al., 2016).

Railroad Pass pluton (middle Miocene)

The Railroad Pass pluton represents the exposed part of the magmatic system that fed the McCullough Mountains stratovolcano of Smith et al. (2010), and mapped as the Dutchman Pass volcanics in this study. Four new U/Pb age dates were acquired in this study on the Railroad Pass pluton and span a range from 14.5 to 13.8 Ma.

Trpa Aplite dikes of the Railroad Pass pluton (middle Miocene) Light tan-gray aplite dikes in the Railroad Pass pluton. Numerous small, unmapped aplite dikes are locally present in the Railroad Pass pluton exposed at Black Hill. Larger map-scale, N- to NE-striking, east-dipping dikes were mapped in one of the smaller Trp outcrops near the western edge of the quadrangle.

Trp Railroad Pass pluton (middle Miocene) Light gray, porphyritic granite, with local fine-grained and mafic marginal phases, all lumped as a single map unit. Trp forms the high-relief Black Hill ridge in the footwall of the Black Hill fault, and is also exposed in the footwall of major dextral-normal faults east of Dutchman Pass. Trp intrudes the Red Mountain volcanics along the exposed northeast margin of the pluton and intrudes the base of the Dutchman Pass volcanic section along the western margins of the pluton. The contact between the Dutchman Pass volcanics and Trp is sharp and mostly dips moderately to steeply west with up to 10s of meters of relief.

Paleoproterozoic Metamorphic Rocks

Xgn Gneiss (Paleoproterozoic) Predominantly garnet-bearing orthogneiss and schist with minor amphibolite. Xgn is exposed in one area near the western edge of the Boulder City NW quadrangle. This small Xgn exposure probably represents a roof pendant or a screen in the upper part of the Railroad Pass pluton.

ACKNOWLEDGMENTS

Research supported by the U.S. Geological Survey, National Cooperative Geologic Mapping Program, under USGS award number G16AC00186. The views and conclusions contained in this document are those of the authors and

should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government. Eugene Smith provided important insight into regional Cenozoic stratigraphic relationships.

REFERENCES

Boland, K.A., 1996, The petrogenesis of andesites produced during regional extension—Examples from the northern McCullough Range, Nevada and Xitle Volcano, Mexico [M.S. thesis]: Las Vegas, University of Nevada, 127 p.

Bell, J.W., and Smith, E.I., 1980, Geologic map of the Henderson quadrangle, Nevada: Nevada Bureau of Mines and Geology Map 67,1 sheet, scale 24,000.

Dee, S., Hinz, N.H., and Anderson, R.E., 2016, Preliminary geologic map of the Boulder City quadrangle, Clark County, Nevada: Nevada Bureau of Mines and Geology Open-File Report 16-4, scale 1:24,000, 6 p.

Faulds, J.E., Smith, E.I., and Gans, P., 1999, Spatial and temporal patterns of magmatism and extension in the Northern Colorado River Extensional Corridor, Nevada and Arizona—a preliminary report, *in* Faulds, J.E., editor, Cenozoic geology of the Northern Colorado River Extensional Corridor, southern Nevada and northwestern Arizona—economic implications of regional segmentation structures: Reno, Nevada, Nevada Petroleum Society 1999 Field Trip Guidebook, p. 171–183.

Felger, T.J, Beard, L.S., Anderson, Z.W., Fleck, R.J., Wooden, J.L., and Seixas, G.B., 2014, Preliminary geologic map of Black Canyon and surrounding region, Nevada and Arizona: U.S. Geological Survey Open-File Report 2013-1267-A, 1 sheet, scale 1:48,000, 23 p.

Fossett, E., 2005, Paleoseismology of the Black Hills Fault, southern Nevada, and implications for regional tectonics, [M.S. thesis]: Las Vegas, University of Nevada, 96 p.

Gans, P.B., and Bohrson, W.A., 1998, Suppression of volcanism during rapid extension in the Basin and Range province, United States: Science, v. 279, p. 66–68.

House, P.K., Buck, B.J., and Ramelli, A.R., 2010, Geologic assessment of piedmont and playa flood hazards in the Ivanpah Valley area, Clark County, Nevada (DVD version): Nevada Bureau of Mines and Geology Report 53.

Langenheim, V.E., Beard, L.S., and Faulds, J.E., 2010, Implications of geophysical analysis on basin geometry and fault offsets in the northern Colorado River extensional corridor and adjoining Lake Mead region, Nevada and Arizona, *in* Umhoefer, P.J., Beard, L.S., and Lamb, M.A., editors., Miocene Tectonics of the Lake Mead Region, Central Basin and Range: Geological Society of America Special Paper 463, p. 39–59, doi: 10 .1130 /2010 .2463 (03).

Smith, E., Honn, D., and Johnsen, R., 2010, Volcanoes of the McCullough Range, southern Nevada, *in* Umhoefer, P.J., Beard, L.S., and Lamb, M.A., editors., Miocene Tectonics of the Lake Mead Region, Central Basin and Range: Geological Society of America Special Paper 463, p. 203–219.

Smith, E.I., 1982, Geology and geochemistry of the volcanic rocks in the River Mountains, Clark County, Nevada and comparisons with volcanic rocks in the nearby areas *in* Frost, E.G., and Martin, D.L., editors, Mesozoic–Cenozoic tectonic evolution of the Colorado River region, California, Arizona, and Nevada: Cordilleran Publishers, San Diego, CA, p. 41–54.

Suggested citation:

Hinz, N.H., Dee, S., and Johnsen, R., 2017, Preliminary geologic map of the Boulder City NW quadrangle, Clark County, Nevada: Nevada Bureau of Mines and Geology Open-File Report 17-5, scale 1:24,000, 5 p.

© Copyright 2017 The University of Nevada, Reno.
All Rights Reserved.