Text and references accompanying Nevada Bureau of Mines and Geology Open-File Report 15-7

Preliminary Geologic Map of the Sloan Quadrangle, Clark County, Nevada

by

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DESCRIPTION OF MAP UNITS

Anthropogenic Features and Deposits

Qx – Anthropogenic deposits (Historic) – Areas of extensive anthropogenic disturbance and modification, including commercial development, mining operations, and major transportation corridors (e.g., Interstate Highway 15).

Quaternary Deposits

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

Qfy – Young alluvium, undivided (late Holocene to late Pleistocene) – Coarse-grained alluvial deposits in intermittently active alluvial fans; typically sandy pebble- to cobble-sized gravel. Surface morphology ranges from fresh bar-and-channel forms to slightly smoothed surfaces, commonly forming low terraces adjacent to Qa. Typical soils have cambic development with Stage I–II $CaCO_3$.

Qfy_1 – Late to middle Holocene alluvium (late to middle Holocene) – Coarse-grained alluvial deposits in intermittently active alluvial fans; typically sandy pebble- to cobble-sized gravel. Surface morphology ranges from fresh bar-and-channel forms to slightly smoothed surfaces, commonly forming low terraces adjacent to Qa. Typical soils have cambic development with Stage I $CaCO_3$.

Qfy_2 – Early Holocene to late Pleistocene alluvium (early Holocene to late Pleistocene) – Coarse-grained alluvial deposits in generally inactive alluvial fans; typically sandy pebble- to cobble-sized gravel. Carbonate clasts are mildly etched and pitted up to 1 cm into clast surface. Generally fully smoothed surfaces with moderately- to well-developed gravel pavement; forms terraces 1–4 m above Qa. Typical soils have cambic to juvenile argillic development with Stage II $CaCO_3$.

Qfi – Intermediate-aged alluvium (late to middle Pleistocene) – Coarse-grained alluvial deposits in mostly inactive alluvial fans; typically sandy pebble- to cobble-sized gravel. Carbonate clasts are etched and pitted up to 4 cm into clast surface. Fully smoothed surfaces with erosionally rounded margins and well developed gravel pavement; commonly little vertical separation from Qfy_2. Argillic soil horizons typically erosionally stripped, with Stage III–IV $CaCO_3$ horizons up to 1.5 m thick.

Qfo – Older alluvium (middle to early Pleistocene) – Coarse-grained alluvial deposits; typically sandy pebble- to cobble-sized gravel. Carbonate clasts are heavily etched and pitted up to 10 cm into clast surface. Fully smoothed surfaces with erosionally rounded margins, locally mantled with angular clasts of pedogenic carbonate and/or eolian silt. Commonly little vertical separation from Qfi. Upper soil horizons erosionally stripped; Stage IV $CaCO_3$ horizons up to a few meters thick.

QTf – Early Pleistocene to late Pliocene alluvium (early Pleistocene to late Pliocene) – Coarse-grained alluvial deposits; typically sandy pebble- to cobble-sized gravel. Fully smoothed to erosionally rounded surfaces commonly mantled with angular clasts of pedogenic carbonate and/or eolian silt. Variable separation from younger surfaces. Upper soil horizons erosionally stripped; Stage V $CaCO_3$ horizons up to several meters thick.

Qls – Landslide deposits (Holocene to late Pleistocene) – A single slope failure deposit, dominated by highly fractured or jumbled bedrock. Forms an uneven, hummocky surface. Located in the northwest part of the quadrangle.

QTls – Older landslide deposits (Pleistocene to late Pliocene) – Slope failure deposits with a wide range in characteristics and composition. Locally dominated by highly fractured or jumbled bedrock. Typically form uneven surfaces, but more smooth than Qls surfaces.

Tertiary Intrusive Rocks

Tdi_2 – Dacite hypabyssal intrusion (middle to late Miocene) – Light gray, porphyritic hypabyssal dacite intrusion that contains ~25% phenocrysts of plagioclase (17%, 1–2.5 mm long) and biotite (8%, 1–2 mm long). This unit forms an irregular shaped body extending greater than 4 km laterally and intrudes Td_2. Previously mapped as the Mount Sutor dacite (Tss) by Bridwell (1991).

Tdi_1 – Dacite dike (middle to late Miocene) – Light gray, porphyritic dacite dike that contains 10% phenocrysts of plagioclase (8%, 1–2 mm long) and biotite (2%, 0.5–1.5 mm long). This dike intrudes Td_1 and probably correlates with the Td_1 dome complex. Previously mapped as part of the Center Mountain dacite (Tsc) by Bridwell (1991).

Tai – Andesite plugs (middle to late Miocene) – Two medium gray aphanitic andesite plugs that intrude Td_1. Probably correlative with Ta.

Tbai – Basaltic andesite dike (middle to late Miocene) – Solitary, aphanitic, medium-dark gray, basaltic andesite dike that is associated with Tba; intrudes Paleozoic basement and the base of Tba. Previously mapped at Alkali basalt (Tab) by Bridwell (1991), but is clearly associated with Tba.

Tertiary Volcanic and Sedimentary Units

Tf – Fanglomerate (late Miocene to Pliocene) – Coarse-grained alluvial deposits; typically sandy pebble- to cobble-sized gravel. Erosional remnants exposed at generally higher elevations than QTf and limited to the west side of the Td_1 dome complex. Upper soil horizons erosionally stripped; Stage V $CaCO_3$ horizons up to several meters thick. This unit may have a gradational contact with QTf.

Td_2 – Young porphyritic dacite (middle to late Miocene) – Light to medium gray, strongly flow-foliated porphyritic dacite dome complex that contains ~10–20% phenocrysts of plagioclase (8–15%, 2 mm long) and biotite (2–5%, 1–3 mm long). This dome complex contains lavas and breccia, is intruded by Tdi_2, and rests in depositional contact on Ta. Previously mapped as Mount Sutor dacite (Tss) by Bridwell (1991). There is no formal "Mount Sutor" to base this name off of.

Tpa – Finely porphyritic andesite (middle to late Miocene) – Medium gray sparsely porphyritic andesite lavas that contain ~8% phenocrysts of plagioclase (6–7%, 0.5–1 mm long) and biotite (1–2%, 0.5–1 mm long). Limited to five closely spaced outcrops south of the Td_1 dome complex. Distinguishable from Ta by phenocrysts content.

Ta – Aphanitic andesite (middle to late Miocene) – Medium gray aphanitic andesite with distinct thin platy flow foliation throughout. Trace plagioclase and biotite phenocrysts were observed in some samples. This unit rests on Tb, Tvc, and locally interfingers with Td_1. Previously mapped as Mount Ian andesite (Tsi) by Bridwell (1991). There is no formal "Mount Ian" to base this name on.

Tvc – Andesite cinders (middle to late Miocene) – Dark gray, coarse-grained, angular, thinly bedded, volcaniclastic cinders, dominantly composed of clasts of Ta. This unit rests in depositional contact under Ta, locally under Tpa, and locally on top of Td_1. Clasts of Td_1 are consistently found in the lower parts of Tvc. Previously mapped as Cinder Prospect Member by Bridwell (1991) which included parts of Td_1 of this study.

Td_1 – Old porphyritic dacite (middle to late Miocene) – Light to medium gray, strongly flow-foliated porphyritic dacite dome complex that contains ~7–8% phenocrysts of plagioclase (5%, 2 mm long) and biotite (2–3%, 1–3 mm long). This dome complex contains lavas, breccia, and tuffs, is locally intruded by Tai and Tdi_1, and locally interfingers with Ta. Previously mapped as Center Mountain dacite (Tsc) by Bridwell (1991). There is no formal "Center Mountain" to base this name on.

Tb – Porphyritic basalt (middle Miocene) – Dark gray, locally vesicular, porphyritic basalt lavas that contain ~10% phenocrysts of olivine (8%, 1–2 mm), pyroxene (<1%, 1–2 mm), and plagioclase (<1%, 1–2 mm). Rests on Tmd, Paleozoic basement, and underlies Ta. Probably correlative with the informally named Hidden Valley basalt (Thv) of Bridwell (1991) that is broadly exposed across the northern McCullough Range.

Tba – Sparsely porphyritic basaltic andesite (middle Miocene) – Medium-dark gray, aphanitic basaltic andesite lavas. Limited to two outcrops near the Sloan quarry that rest on Paleozoic basement and Tbs. Previously mapped at Alkali basalt (Tab) by Bridwell (1991), but is clearly a separate unit with Tbs separating the two units.

Tmd – Tuff of Mount Davis (15.0 Ma; Faulds et al., 2002a, b) – Light grayish-pink, weathering pale-brown,

moderately welded, rhyolitic ash-flow tuff that contains ~18–22% phenocrysts of sanidine (14–18%, 1–3 mm and up to 6 mm long), plagioclase (2–3%, 1–3 mm long), biotite (1–2%, 0.5–1.5 mm long), and sphene (trace). Sphene is very rare; only observed in one hand sample. Distinguished from Tbs by virtual absence of sphene, greater average phenocrysts concentration, and large floating sanidine phenocrysts (5–6 mm long). Limited to two areas in the Sloan quadrangle; east of Interstate Highway 15 where it underlies Ta, and secondly, near the Sloan quarry.

Tbs – Tuff of Bridge Spring (15.2 Ma; Faulds et al., 2002a, b) – Purplish-gray to light-gray, weathering pale-brown, moderately to densely welded rhyolitic ash-flow tuff that contains 15% phenocrysts of sanidine (13–14%, 1–2 mm long), plagioclase (2–3%, 1–2 mm long), biotite (<1%, 0.5–1.5 mm long) and distinctive, honey-yellow sphene (<1%, <1 mm long). Basal dark-gray vitrophyre commonly found at base. Distinguished from Tmd by presence of ubiquitous sphene, somewhat smaller sanidine phenocrysts, and lower average concentration of overall phenocrysts. This unit rests on Tg, Tpba, and Paleozoic basement and exposures are limited to the west half of the quadrangle.

Tob – Olivine basalt (middle Miocene) – Medium gray, vesicular, porphyritic basalt lavas that contains ~5% anhedral olivine (1–8 mm long). This unit is limited to a solitary outcrop near the Sloan quarry where it underlies Tg and rests on Paleozoic basement. Previously mapped as Alkali basalt (Tab) by Bridwell (1991). Tab is an informal name established by Bridwell and included lumped Tob and Tba from this study that are clearly separate units.

Tpba – Pyroxene basaltic andesite (middle Miocene) – Dark gray, porphyritic, locally vesicular, basaltic andesite lavas that contains ~20% phenocrysts of black pyroxene (15%, 1–5 mm long), plagioclase (2–3%, 1–2 mm long), and olivine (2–3%, 1–1.5 mm long). This unit interfingers with Tg and underlies Tbs. Possibly correlative with the informally named Cactus hill basalt (Tchb) of Bridwell (1991).

Tg – Fluvial gravels, undivided (middle Miocene to Paleocene or Late Cretaceous) – Well-rounded cobble to boulder gravel and minor sandstone. Correlative with Trg (roundstone gravels) mapped in the Jean quadrangle directly southwest of the Sloan quadrangle (Garside et al., 2012) and probably in part correlative with the McCullough Spring conglomerate (Herrington, 2000). Tg locally includes Tgx, Tgc, and Ts.

Tgx – Crystalline gravels, undivided (middle Miocene to Paleocene or Late Cretaceous) – Well-rounded cobble to boulder gravel. Mixture of Paleozoic carbonate clasts and Proterozoic crystalline and quartzite clasts. Typically clast supported and massively bedded with sparse sandy horizons; local pebble imbrication. Sub-unit of Tg and interbedded with Tgc.

Tgxu – **Upper crystalline gravels** – up to 165 m thick, interbedded with Tpba and Tbs

Tgxm – **Middle crystalline gravels –** up to 30 m thick

Tgxl – **Lower crystalline gravels –** up to 65 m thick

Tgc – Carbonate gravels, undivided (middle Miocene to Paleocene or Late Cretaceous) – Well-rounded cobble to boulder gravel. Predominantly composed of Paleozoic carbonate clasts. Typically clast supported and massive to thickly bedded with sparse sandy horizons; local pebble imbrication. Sub-unit of Tg and interbedded with Tgx.

Tgcu – **Upper carbonate gravels** – up to 60 m thick

Tgcm – **Middle** c**arbonate gravels –** up to 10 m thick

Tgcl – **Lower** c**arbonate gravels –** up to 30 m thick

Ts – Sandstone (middle Miocene to Paleocene or late Cretaceous) – Coarse, thinly bedded, moderately cemented sandstone, interbedded with Tg.

Paleozoic Sedimentary Rocks

Bird Spring Formation (Early Permian to Late Mississippian)

PMbs – Bird Spring Formation, undivided (Late Mississippian to Permian) – Includes units A through D and undivided Bird Spring that is younger than unit D.

PMbsd – Bird Spring Formation, unit D (Late Mississippian to Pennsylvanian) – Light- to dark-grey, medium- to thick bedded limestone. Minor sandstone interbeds. Estimated thickness greater than 60 m. Distinguished from PMbsc by absence of reddish sandstone beds.

PMbsc – Bird Spring Formation, unit C (Late Mississippian to Pennsylvanian) – Reddish to yellowish sandstone and grey limestone. Sandstone commonly crossbedded and darkly varnished. Estimated thickness 20–30 m. Distinguished from

PMbsb and PMbsd by consistent presence of reddish sandstone beds.

PMbsb – Bird Spring Formation, unit B (Late Mississippian to Pennsylvanian) – Tan to gray cherty limestone and dolomite. Lower half typically tan to yellowish dolomite; upper half typically gray limestone with prominent varnished chert layers and localized sandstone interbeds. Estimated thickness 60–150 m. Distinguished from PMbsa by presence of cherty layers and distinguished from PMbsc by absence of reddish sandstone.

PMbsa – Bird Spring Formation, unit A (Late Mississippian to Pennsylvanian) – Light- to dark-gray, medium-bedded limestone. Gradational with underlying Yellowpine Member of the Monte Cristo Limestone. Estimated thickness 20–50 m. Distinguishable from Mmy and PMbsb by absence of cherty beds.

Monte Cristo Group (Late to Early Mississippian)

Mmy – Yellowpine Limestone – Medium-dark-gray to light-olive-gray, medium-crystalline, thin- to thick-bedded limestone, commonly recrystallized to medium- to very light gray, coarse-grained dolomite; contains sparse nodules of gray to brown chert, particularly near the contact with underlying Mmb and near the overlying contact with PMbs. The contact between Mmy and Mmb is commonly marked by a 10–30 cm-thick chert bed. Commonly contains abundant rugose corals in contrast to Mmb. Thickness approximately 75–100 m.

Mmb – Bullion Limestone – Light-gray limestone, commonly recrystallized to medium- to very light gray, coarse-grained dolomite. Chert is uncommon, in contrast to the underlying Mma. Thickness approximately 85–100 m.

Mma – Anchor Limestone – Alternating thin-bedded limestone and orange-weathering, light-gray, commonly nodular and layered chert. Chert beds commonly 5–10 cm thick. Limestone is medium-gray to light-olive-gray, partly burrowed, and fine- to medium-crystalline. Thickness approximately 25–50 m.

Mmd – Dawn Limestone – Dark-gray and brownish-gray, thin-bedded to massive, bioclastic limestone. Local nodules of brown chert, but the unit is relatively chert-free in contrast to overlying Mma. Thickness approximately 50 m.

MDcp – Crystal Pass Limestone (Early Mississippian to Late Devonian) – Very light gray, locally light pinkish-gray, very fine-grained, ledgy, medium- to thin-bedded limestone. Fine laminations commonly visible on weathered surfaces. Distinctive light-gray bench between darker-gray Sultan Limestone below and Dawn Limestone above. Typically not secondarily dolomitized. Thickness approximately 50 m.

Ds – Sultan Limestone (Middle and Early Devonian) – Medium-dark tan-brown, medium gray, and locally light gray fine- to coarse-grained dolomite. Forms a distinctive dark gray-brown exposure at the base of the cliff at the Sloan quarry and at the base of the exposed Paleozoic section east of the Interstate Highway 15. The base of Ds is not exposed in the Sloan quadrangle. Minimum thickness is greater than 100 m.

REFERENCES

Bridwell, H.L., 1991, The Sloan Sag—a Mid-Miocene volcanotectonic depression, north-central McCullough Range, southern Nevada [M.S. thesis]: Las Vegas, University of Nevada, 147 p.

Faulds, J.E., Bell, J.W., and Olson, E.L., 2002a, Geologic map of the Nelson SW quadrangle, Clark County, Nevada: Nevada Bureau of Mines and Geology Map 134, scale 1:24,000, 15 p.

Faulds, J.E., Olson, E.L., Harlan, S.S., and McIntosh, W.C., 2002b, Miocene extension and fault-related folding in the Highland Range, southern Nevada—a three-dimensional perspective: Journal of Structural Geology, v. 24, p. 861–886.

Garside, L.J., House, P.K., Burchfiel, B.C., Rowland, S.M., and Buck, B.J., 2012, Geologic map of the Jean quadrangle, Clark County, Nevada: Nevada Bureau of Mines and Geology Map 176, 1 sheet, 1:24,000 scale, 11 p.

Herrington, J.M., 2000, Evolution of the Kingman Arch, southern Nevada [M.S. thesis]: Las Vegas, University of Nevada, 83 p.

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