Text and references accompanying Nevada Bureau of Mines and Geology Open-File Report 16-3

# Preliminary Geologic Map of the Apex Quadrangle, Clark County, Nevada

*by*

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## SUMMARY

The Apex 7.5′ quadrangle is in Clark County, Nevada, about 25 km to the northeast of downtown Las Vegas, between the high parts of the Sheep Range to the west and southern Dry Lake Valley to the east (figure 1). The southwest end of the Dry Lake Range is in the northeast corner of the quadrangle and Sunrise Mountain is a few kilometers to its south. Mountainous terrain of the Las Vegas Range in the northwest corner of the quadrangle is separated from the Dry Lake Range by a valley along the I-15 corridor. The southern half of the

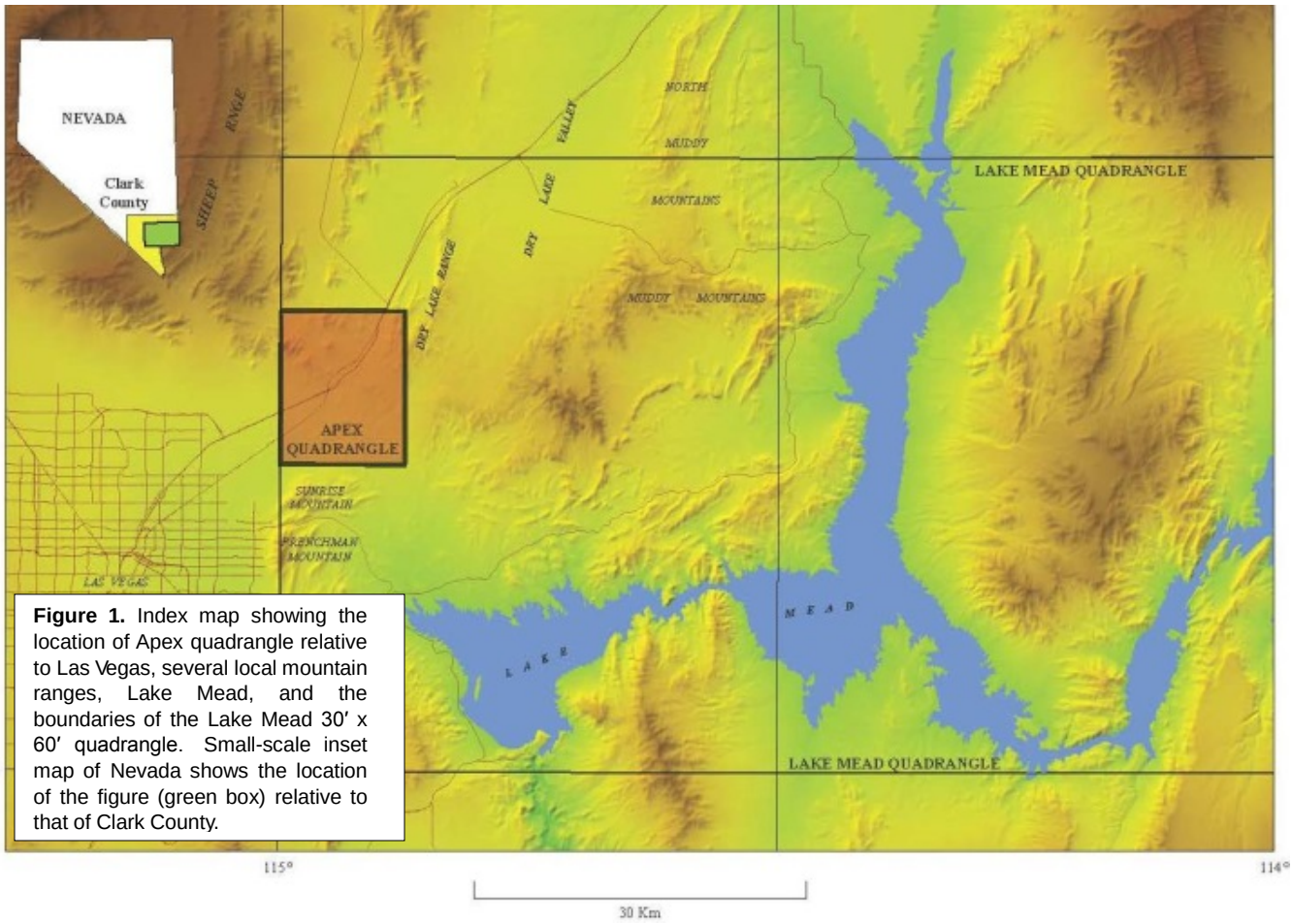


**Figure 1.** Index map showing the location of Apex quadrangle relative to Las Vegas, several local mountain ranges, Lake Mead, and the boundaries of the Lake Mead 30′ x 60′ quadrangle. Small-scale inset map of Nevada shows the location of the figure (green box) relative to that of Clark County.

quadrangle has low relief and lower elevations.

The Apex quadrangle is one of the large-scale maps on the western border of the Lake Mead 30′ x 60′ (1:100,000) quadrangle (figure 1), the geology of which was published by Beard et al., (2007). It is adjacent to the east edge of the Las Vegas 30′ x 60′ (1:100,000) quadrangle that was mapped by Page et al., (2005). Castor et al., (2000) mapped the geology of the adjacent Frenchman Mountain 7.5′ quadrangle to the south, and Lundstrom et al., (1998) mapped the Valley 7.5′ quadrangle to the west.

The geology of the northern, mountainous part of the quadrangle is chiefly that of Paleozoic shelf carbonate strata deformed by at least one major northwest dipping thrust fault of Sevier age (Late Cretaceous) and numerous normal faults of Miocene age. The largest thrust fault is the Dry Lake thrust that is oriented northeast along the western flank of the Dry Lake Range. The Dry Lake thrust fault is part of a stacked thrust system known locally as the Sevier orogenic belt (Armstrong, 1968). The Dry Lake thrust is reported to die out to the north in the Arrow Canyon Range (Page and Dixon, 1992). The Dry Lake Range is in the footwall of the thrust and the hanging wall is to the west in the Arrow Canyon and Las Vegas ranges. Additional Sevier thrusts exposed to the east, such as the Muddy Mountain thrust, probably underlie both ranges at depth and higher thrusts have been described to the west in the Sheep Range (Armstrong, 1968; Page et al., 2005; and Guth, 1990). Thus, the exposed rocks in the northern part of the quadrangle are in the middle part of the stacked thrust system.

In contrast, the bedrock of Frenchman and Sunrise mountains, to the south of the quadrangle, is of autochthonous platform strata known to underlie or have been well east of all of the Sevier thrusts (Armstrong, 1968; and Castor et al., 2000). The Las Vegas Valley shear zone, a major fault zone upon which the major deformation occurred between 14 and 8.5 Ma (Duebendorfer and Black, 1992) separates these two disparate terranes and has possibly 60 km or more of right slip (Stewart, 1967; Page et al., 2005; and Wernicke et al., 1988). It is highly likely that the shear zone, which is oriented northwest, passes beneath the southern part of the Apex quadrangle where it is buried by the upper Miocene and Pliocene strata of the Muddy Creek Formation (Page et al., 2005). Those strata have been dated as being largely younger than 6 Ma (Castor and Faulds, 2001). Although the shear zone is not exposed, deformation in the post 6 Ma rocks is locally intense near small faults oriented northeast and northwest, and it may be the result of the last gasp of subsurface deformation on the shear zone. But the geometry of faulting does not match the classic Riedel shear geometry of west-northwest right-slip and northeast left-slip faults that would be expected of a buried dextral fault system like the Las Vegas Valley shear zone; instead it appears more consistent with sinistral slip (Hills, 1963). More work may be needed here.

# DESCRIPTION OF MAP UNITS

## Anthropogenic Features and Deposits

**Qm – Mine workings (Holocene**) – Areas where major excavation or filling by people has disturbed the land surface to the extent that its pre-existing natural character cannot be accurately determined.

## Quaternary to Pliocene Deposits

**$Qa_4$ – Alluvium (Holocene) –** Active channel alluvium, consisting of silt, sand, and pebble- to boulder gravel; unconsolidated and poorly sorted. Deposited in most active channels. No calcic soil horizon or desert pavement development. Bar and swale topography common. Typically inset into topographically higher and older alluvial units, but locally overlies them. Maximum terrace height is 10 m, but typically much lower.

**Qaf – Fan alluvium (Holocene) –** Active fan alluvium, consisting of silt, sand, and pebble to boulder gravel; unconsolidated and poorly sorted. Deposited in most active floodplains, low terraces, and alluvial fans. No calcic soil horizon or desert pavement development. Bar and swale topography common. Maximum terrace height is 10 m, but typically much lower.

**Qs – Sand (Holocene to late Pleistocene) –** Unconsolidated windblown sand, mostly quartz, fine-grained, in thin sheets and small dunes. Thickness 0 to 2 m.

**Qct – Colluvium and talus (Holocene to Pleistocene) –** Angular, poorly sorted, locally derived blocks of rock and colluvial material, mantling slopes, and at base of cliffs or steep slopes. Widespread in quadrangle but mapped only locally. Thickness 0 to 10 m.

**$Qa_3$ – Alluvium (late Pleistocene**) **–** Channel alluvium, consisting of silt, sand, and pebble- to boulder gravel; unconsolidated and poorly sorted. Deposited in young channels, slightly elevated relative to $Qa_4$ where present in the same channel. No calcic soil horizon or desert pavement development. Bar and swale topography common. Maximum terrace height is 10 m, but typically much lower.

**$Qa_2$ – Alluvium in side streams and thin fans (late to middle Pleistocene) –** Alluvium of local derivation, consisting of sand and gravel in dissected alluvial fans and low to intermediate terraces in washes. In upland areas with gentle gradients, surfaces are typically smooth, commonly exhibiting well-developed desert pavement.

**$Qa_1$ – Older alluvium (middle to early Pleistocene) –** Alluvium of local derivation, consisting of sand and gravel

in dissected alluvial fans and low to intermediate isolated terraces that are typically far from washes. In upland areas with gentle gradients, surfaces are typically smooth, commonly exhibiting well-developed desert pavement.

**Qau – Alluvium, undivided (late to early Pleistocene) –** Unconsolidated gravel and sand near west edge of map.

**QTca – Calcrete and alluvium (early Pleistocene to late Pliocene) –** Thick calcrete soil in upper parts of alluvial fan deposits. Calcrete soil exhibits laminar carbonate layers at top, breaks across imbedded clasts. Up to 2 m thick, classified as Stage IV or higher carbonate development. Mainly in fans associated with late stages of subsidence of the southern end of Dry Lake Valley. Thickness not known, but probably greater than 10 m in some areas.

**Tc – Calcrete deposits (late to middle Pliocene) –** Stage V or greater calcrete soil, 5–10 m thick. Exposed mainly in west-central part of quadrangle, where deposits are continuous with extensive exposures in western California Wash. Thickness about 10 m.

**Tg – Gravel (Pliocene) –** Highly dissected, locally derived alluvial fan deposits that occur on or near bedrock exposures in the vicinity of California Wash. Geomorphic position suggests fans aggraded above regional top of Muddy Creek Formation, which formed the floors of Dry Lake Valley, California Wash, Overton Arm, and Boulder Basin, prior to dissection by the Colorado and Virgin rivers. Probably equivalent to aggradational gravels as described by Schmidt (1994), Schmidt et al., (1996), Swadley et al., (1995) and Williams et al., (1997). Thickness about 10 m.

## Pliocene to Miocene Sedimentary Rocks

**Tu – Undivided Tertiary rocks (Pliocene to late Miocene) –** In cross section only.

**Muddy Creek Formation (Pliocene to late Miocene)**

**Tmf – Siltstone and sandstone facies (Pliocene to late Miocene) –** Very fine-grained sandstone and siltstone; moderate sorting, calcite and clay cement; pale brown to pale pink in color. Bedding is parallel and semi-continuous with even bed thickness of several cm to 50 cm. This facies is typical of fine-grained Muddy Creek Formation in many other areas to the east of Dry Lake Valley and California Wash. It most likely comprises the bulk of the fine-grained fill in those two basins. 20 m thick in quadrangle, but is probably much thicker elsewhere.

**Tmc – Claystone and marl facies (late Miocene) –** Brown claystone and thin yellow-gray- to white marl beds. Marl mostly confined to lower part of facies, claystone makes up bulk of unit.

**Tml – Limestone facies (late Miocene) –** Pale tan- to white biochemical and crystalline limestone. Beds are wavy, parallel, and moderately continuous. Bed thickness is even, averaging 20 cm. Many beds have fine internal laminations.

**Tms – Sandstone facies (late Miocene) –** Brown sandstone, poorly exposed in southern part of quadrangle mostly within confines of restricted area north of Frenchman Mountain. A sample of tuff from this unit was reported to be about 6 Ma according to Castor and Faulds (2001). Not studied in detail.

**Horse Spring Formation (middle Miocene)**

**Thbl – Bitter Ridge Limestone Member –** Resistant biochemical and crystalline limestone in small exposure near southeast corner of map.

**Tht – Thumb Member –** Brown sandstone in small exposures near southeast corner of map.

## Paleozoic Rocks

**Pe – Esplanade Sandstone redbeds (Early Permian) –** Medium- to fine-grained, dull red, reddish-pink, and white- to yellow sandstone. Thick- to thin-bedded, unlaminated- to cross-laminated. Weathers in alternating thin, slightly resistant beds and intervening soft slopes, forming stair step topography. Outcrops commonly mantled by colluvium derived from overlying Toroweap Formation and Kaibab Limestone. Mapped as Lower Permian redbeds in Las Vegas quadrangle to west (Page et al., 2005); partly correlative to Hermit Formation and Esplanade Sandstone (unit Pe) as mapped to east in autochthonous rocks. About 400 m thick.

**Pp – Pakoon Limestone (Early Permian) –** Light-gray, thin-bedded limestone, dolomite, and gypsum. Exposed in Dry Lake Range, northeast part of quadrangle, in vicinity of Dry Lake thrust and within thrust fault slivers. Equivalent to upper part of Bird Spring Formation (PMb) in upper plate of Dry Lake thrust to west. Thickness unknown, perhaps as much as 100 m.

**Bird Spring Formation (Asselian to Serpukhovian)** — Gray and yellowish-gray bioclastic limestone, dolomite, siltstone, silty limestone, brown sandstone, and some gray and red shale. Contains abundant discontinuous layers and nodules of gray- to brown chert. Members of the Bird Spring Formation ($Pb_6$, $Pb_{4–5,}$ $PMb_{1–3,}$) are from Lundstrom et al., (1998).

**$Pb_6$ – Upper part (Early Permian) –** Consists mainly of gray, cherty, bioclastic limestone with interbeds of brown sandstone.

**$Pb_{4–5}$ – Middle part (Early Permian) –** Contains distinctive red, silty limestone marker unit with submarine debris flows and turbidite beds that represent a slope- to basin sequence, in contrast to the carbonate shelf sequence that typifies most of the Bird Spring Formation in the region.

**ℙ$Mb_{1–3}$ – Lower part (Desmoinesian to Chesterian) –** Consists mainly of medium-gray and yellowish-gray bioclastic and arenaceous limestone, dolomite, and chert, with some red and gray shale beds.

**Mi – Indian Springs Formation (Chesterian) –** Interbedded yellowish-gray bioclastic limestone, black and red shale, and tan sandstone and quartzite. Limestone is thin-bedded and finely- to coarsely crystalline. Shale occurs mostly in lower part of formation. Quartzite and sandstone grains are fine-grained, subrounded, and moderately sorted. About 50 m thick.

**Monte Cristo Group (Late to Early Mississippian)**

**Mmy – Yellowpine Limestone (Meramecian and late Osagean) and Arrowhead Member (late Osagean), undivided –** Mostly Yellowpine Limestone, which is a medium-dark-gray- to light-olive-gray medium-crystalline and thin- to thick-bedded limestone. Contains sparse nodules of gray- to brown chert. Contains unusually large solitary rugose corals (up to 25 cm) especially near top. Arrowhead Limestone is a thin recessive limestone unit at base that is either discontinuous or is not recognizable in all exposures. About 80 m thick.

**Mmb – Bullion Limestone (early Meramecian to middle Osagean) –** Medium-light-gray encrinitic wackestone- to grainstone. Contains some beds of dusky yellow-brown weathering chert. 100–180 m thick.

**Mmdol – Dolomitic zone (series unknown) –** Strongly altered and dolomitized rock, originally Yellowpine, Arrowhead, or Bullion Limestones, but now those units cannot be distinguished. Extent not known, especially in subsurface. Irregular boundaries, only partly controlled stratigraphically. Coarse-grained crystalline dolomite, chiefly light gray in color. Thickness 0–180 m.

**Mma – Anchor Limestone (Osagean) –** Alternating thin-bedded limestone and chert. Limestone is medium-gray- to light-olive-gray, partly burrowed and fine- to medium crystalline. Chert is dark-gray and weathers moderate- to light-orange-brown. Chert lenses define subparallel, discontinuous uneven bedding surfaces 5–20 cm thick. 140–180 m thick.

**Mmd – Dawn Limestone (early Osagean to Kinderhookian) –** Dark-gray, brownish-gray, and light-olive-gray thin-bedded to massive bioclastic, oolitic limestone. Commonly contains elongate nodules and discontinuous lenses of brown chert. 70 m thick.

**Mmu – Monte Cristo Group, undivided (Late to Early Mississippian) –** In cross section only.

**MDc – Crystal Pass Limestone (early Kinderhookian to late Famennian) –** Light-gray, thin-bedded to massive micrite to carbonate mudstone. Mostly planar bedding, but locally cross-laminated. Forms steep cliffs. About 75 m thick.

**Dg – Guilmette Formation (Late to Middle Devonian) –** Equivalent to lower part of Sultan Limestone in northern Spring Mountains. Medium-dark-gray- to light-brown-gray dolomite and limestone with minor amounts of dolomitic quartzite. Cyclic limestone and dolomite beds that are internally laminated and burrow-mottled. Mostly forms cliffs. Contains distinct dark-gray dolomite with abundant stromatoporoids. 490 m thick.

**MDu – Crystal Pass Limestone and Guilmette Formation, undivided (Late to Middle Devonian) –** In cross section only.

**Oes – Ely Springs Dolomite (Late Ordovician) –** Dolomite, medium-dark-gray, burrow-mottled, irregularly thin- to medium-bedded, with common planar laminations. About 150 m thick.

**Oe – Eureka Quartzite (Middle Ordovician) –** Quartzite and friable sandstone, light-to-moderate-brown-weathering, white- to light-brown where fresh, thin- to thick-bedded. Quartz grains are rounded to subrounded and moderately well sorted. Contains tabular planar cross-beds and less commonly trough cross-beds occur. About 30 m thick.

**O€p – Pogonip Group, undivided (Middle Ordovician to Late Cambrian) –** Limestone, dark-yellow-brown to yellow-orange, massive- to medium-bedded. Local thickness not known, about 400 m thick in Arrow Canyon Range.

**€n – Nopah Formation (Late Cambrian) –** Dolomite, mottled light- to medium-gray, crystalline and thin- to thick-bedded. Includes discontinuous layers of yellow-brown weathering chert. About 360 m thick.

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