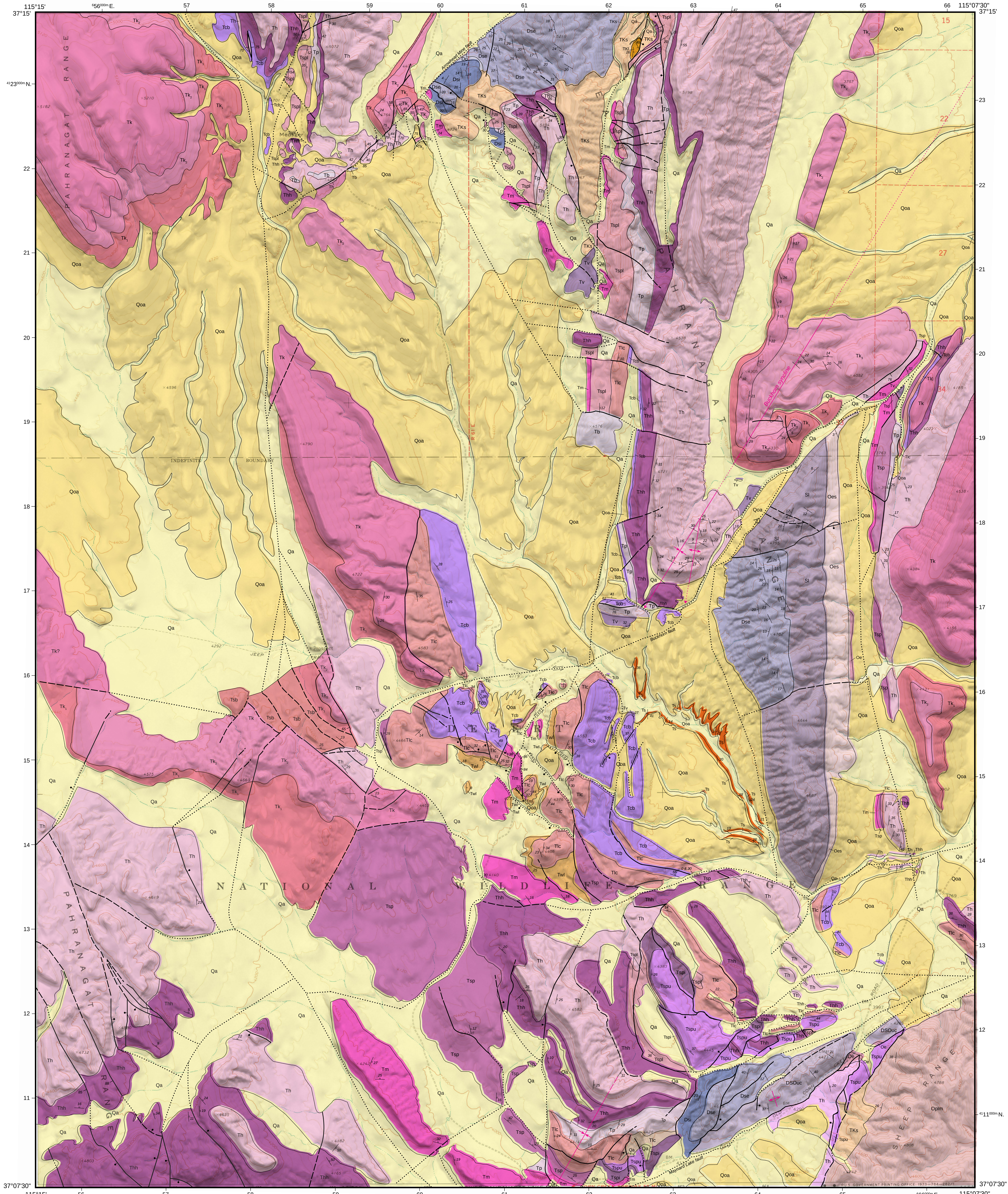

PRELIMINARY GEOLOGIC MAP OF THE LOWER PAHRANAGAT LAKE NW QUADRANGLE, LINCOLN COUNTY, NEVADA

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QUATERNARY STRATIGRAPHY

Qa — **Quaternary alluvium and fan deposits** Gravely sand and clayey, silty sand with sub-angular to rounded pebble- to boulder-sized clasts. The clasts are mostly composed of tuff, carbonate and quartzite from nearby Oligocene–Miocene and Paleozoic units. The deposit surface is less compacted and erosionally dissected than the older Quaternary deposits (Qoa). It can be distinguished clearly by its poor sorting and soft surface. Locally includes the Quaternary wash deposits and colluvium.

Qoa — **Quaternary older alluvium** Generally poorly sorted sediments; gravely sand, and sandy gravel; sub-angular to rounded clasts; include various clast types from the surrounding rocks including clasts of tuff, quartzite, dolomite and limestone. The Qoa lies at a higher elevation than the Qa. In addition, Qoa is bedded, compacted and moderately cemented; usually the beds are exposed in cut banks where dissected. Small ridge-and-ravine topography is common.

TERTIARY STRATIGRAPHY

The phenocryst descriptions were compared to the quantitative phenocryst analyses done by Best et al. (1993) for the identified units within the study area. Where new counts were not done, phenocrysts percentages from Best et al. (1993) are reported. The ages of the identified units were derived from previous studies (Best et al., 1993, 2013a, b; Scott et al., 1993; Jayko, 2007).

Ts — **Tertiary sediments** Fluvial to alluvial siltstones, sandstones, and conglomerates; locally cross bedded. Weathers tan to orange-brown and contains sub-angular to sub-rounded clasts of Oligocene–Miocene tuffs and Paleozoic marine units.

Tb — **Basalt** Grayish to gray-black, fresh and weathered; aphyric with sparse phenocrysts; massive center with more vesicular top and bottom.

Tk, Tk_3, Tk_2, Tk_1 — **Kane Wash Tuff** (~14.7 Ma) Crystal-poor, poorly to highly welded ash-flow tuff that is zoned from rhyolite to trachyte; divided into three sub-units: the lower called 1, middle called 2, and upper called 3. Unit 1 is poorly welded with notable lithic fragments; unit 2 and 3 are moderately to highly welded. Phenocryst total averages about 10% of the rock. Modal phenocryst percentages are approximately 5–40% quartz and 54–75% sanidine with a variety of accessory minerals. Thickness of all subunits 200m.

Th — **Hiko Tuff** (18.51 Ma) Crystal-rich rhyolitic ash-flow tuff; typically moderately to densely welded; however, it includes a less welded, lower, lithic zone in some locations. Color varies from grayish red purple to grayish purple. A thin layer of ash-fall tuff sits below the Hiko Tuff and on top of the Harmony Hills Tuff. The unit contains 30–40% total phenocrysts and has modal percentages of: 10–35% quartz, 15–35% sanidine, 30–65% plagioclase, 5–15% biotite, 0–5% hornblende, and trace clinopyroxene and titanite. Thickness 50–200m.

Thh — **Harmony Hills Tuff** (22.56 Ma) Crystal-rich andesitic ash-flow tuff that ranges from highly to poorly welded. Contains relatively large phenocrysts and has flattened pumice. The color varies from very dark grayish red on weathered surfaces to grayish red on fresh surfaces. Locally, the uppermost part of the Harmony Hills includes a thin layer of a fluvial deposit with lithic ash-flow tuff. The thickness decreases to the east and is thickest in the southwest corner of the quadrangle, where it may contain two cooling units, and it pinches out in the southeastern part. The phenocryst assemblage is: 0–10% quartz, 0–3% sanidine, 55–70% plagioclase, 10–20% biotite, 0–15% hornblende, and 0–5% clinopyroxene with a total of 40–50% phenocrysts. Thickness 50–200m.

Tp — **Pahranagat Formation** (22.93 Ma) Crystal-rich rhyolitic ash-flow tuff; highly to moderately welded; commonly with a poorly welded base; color varies from grayish orange to light reddish brown. The Pahranagat Formation pinches out within the quadrangle. The total phenocryst percentage is 20–45% total and modal percentage is: 21–49% quartz, 16–42% plagioclase, 22–42% sanidine, and 1–6% biotite. Adularescent sanidine is common. Thickness 20–50m.

Tcb — **Bauers Tuff Member of the Condor Canyon Formation** Relatively phenocryst poor, rhyolitic ash-flow tuff; densely to partially welded; brown to red brown; large, light gray fiamme. Contains 10–20% total phenocrysts composed of 15–45% sanidine, 35–70% plagioclase, 0–10% biotite and trace clinopyroxene. Thickness 10–50m.

Tlc — **Leach Canyon Formation** (24.03 Ma) Dark to light grayish orange, rhyolitic ash-flow tuff; partially welded, pumice is dark colored; lithic fragments are common. The total phenocryst percentage is 10–30% with modal percentages of: 20–50% quartz, 5–40% sanidine, 20–55% plagioclase, and 0–15% biotite. Thickness 30–200m.

Twl — **Water-laid sediments and tuffs** White, very light gray and light tan water-laid sediments and ash-fall tuffs. Sediments are bedded siltstone to sandstone composed of ash and transported crystals commonly of quartz, sanidine, plagioclase, and biotite; locally cross bedded. Ash-fall tuffs are rhyolitic, contain small percentages of total phenocrysts and form massive beds.

Tsb — **Undivided Shingle Pass and Bauers Tuffs** Either Shingle Pass or Bauers Tuffs. Crystal assemblage is plagioclase > sanidine > biotite with about 10–20 percent total phenocrysts.

Tv — **Undivided tuffs** Unidentified Tertiary tuffs and units with a local distribution.

Tsp, Tspu, Tspi, Tspl — **Shingle Pass Tuff** (26–27 Ma) Dark grayish red to grayish red, brown, orange, red, or purple, relatively crystal-poor rhyolitic ash-flow tuff; white to pastel-colored pumice lapilli. Subdivided into three mappable units, but only two occur in the northern part of the quadrangle and three occur in the south. For all units either sanidine or plagioclase is the most common phenocryst. The lower member (Tspl) has 10–20% total phenocrysts; 5–15% quartz, 45–60% sanidine, 25–35% plagioclase, and trace biotite. The middle member (Tspi) has 5–15% total phenocrysts: 5% quartz, 25–50% sanidine, 55–60% plagioclase, and 5–10% biotite. The upper member (Tspu) has 5–10% total phenocrysts with trace quartz, 30–40% sanidine, 50–60% plagioclase and 5–10% biotite. Thickness of all subunits 50–200m.

Tm — **Monotony Tuff** (27.57 Ma) Crystal-rich, dacitic ash-flow tuff. The color ranges between grayish orange to dark grayish orange; 10–60% total phenocrysts on average, but grades upwards from medium to high amounts of phenocrysts. Lower part is poorly welded with the upper section more welded. The phenocryst percentages are: 5–30% quartz, 0–15% sanidine, 45–65% plagioclase, 5–20% biotite, 0–10% hornblende, and 0–10% clinopyroxene. Large purple amethyst and obvious biotite are apparent in hand samples. The Monotony Tuff is the oldest unit of the pyroclastic section within the quadrangle.

TKl, TKs — **Tertiary–Cretaceous sediments** Conglomerate and freshwater limestone (locally mapped as TKl). The conglomerate is bedded, poorly sorted, with sub-angular pebbles and cobbles of various Paleozoic carbonate and quartzite units; up to 90% limestone clasts. The freshwater limestone is light gray to tannish gray and typically darker colored fresh than weathered; commonly vuggy. The TKs unconformably overlies Paleozoic units that range from Ordovician Pogonip Group to the Devonian carbonates. TKs is unconformably overlain by Tertiary tuffs including the oldest in the area, the Monotony Tuff. Thicknes of TKs less than 10m.

PALEOZOIC STRATIGRAPHY

Dsi — **Simonson Dolomite** Consists of alternating bands of dark and light yellow-gray color, coarse to fine crystals of dolomite. The lowest sub-unit is a coarse grained, light tan, crystalline cliff-forming dolomite ranging from 160 to 310 feet (48–94 m) thick. The middle sub-unit is composed of an alternating sequence of whitish gray dolomite resembling the Sevy Dolomite and brown, fine- to medium-grained dolomite. Large stromatoporoids are common in this sub-unit. Its thickness ranges from 250 to 400 feet (76–121 m). A brown cliff-forming sub-unit is the third unit; it is a dolomite containing stromatoporoids, corals and bryozoans. This dolomite member is massive and has a thickness range of 70 to 180 feet (70–54 m). The highest sub-unit is an alternating light and dark member that resembles the lower sub-unit, but it has thicker beds and fewer laminations. Sedimentary breccias occur in this 200 to 460 foot (60–140 m) thick uppermost sub-unit. The uppermost 50 feet (15 m) may contain Stringocephalus. Thickness 300–400m.

Do — **Oxyoke Canyon Sandstone** Yellowish brown, well-sorted medium- to fine-grained sandstone; locally cross bedded; upper contact with Simonson is gradational. Regionally it may be grouped with Simonson Dolomite.

Dse — **Sevy Dolomite** Homogenous, unfossiliferous, microcrystalline dolomite that commonly weathers whitish gray. On fresh surfaces it can be tan, gray, or pinkish gray. Two sub-units were identified in the field: a lower sub-unit that mostly consists of yellowish gray, fine phaneritic to aphanitic dolomite, and an upper sub-unit that contains interbedded sandstone zones that are commonly brecciated. In the southern part of the area these sandstones were mapped with Dse. Thickness 125–130m.

DSOuc — **Undefined carbonate unit** Dark gray, medium- to fine-grained dolomite; chert is common locally. No fossils where found; the rocks are highly brecciated and/or sheared, but lithology, bedding thickness, color, and chert morphology suggest that this unit is most likely one of the Devonian, Silurian and/or Ordovician formations. Thickness 50m.

Sl — **Laketown Dolomite** Light and dark gray, medium- to coarse-grained, crystalline dolomite; commonly has a banded appearance, alternating dark dolomite with light gray dolomite. Fossils and chert nodules are present in some layers. Thickness 200–225m.

Oes — **Ely Springs Dolomite** Medium- to coarse-grained, dark-gray dolomite; fossiliferous and typically cherty. Significant portions of the lower half of the formation are partially dolomitized gray limestone. The lower 50 feet (15.25 m) is commonly limestone with about 30% chert. Thickness 150m.

Oe — **Eureka Quartzite** Vitreous orthoquartzite; medium- to fine-grained; cross bedded; well sorted, well-rounded grains. Commonly weathers to rusty, yellow-brown, or red color; white to nearly white where fresh; locally the Eureka Quartzite is highly brecciated. Its lighter color makes it stand out as a white band between gray carbonate rocks. Thickness ~50m.

Oplm — **Pogonip Group** Gray limestone with shale, siltstone, and silty limestone. Three sub-units of Pogonip Group were identified within the Pahranagat Range (Reso, 1963); only the lower and middle units are exposed in the quadrangle and they are mapped together as one unit; the lower consists of abundant chert nodules in gray limestone; locally contains pebble conglomerate with sandy beds; no fossils were found. The middle unit consists of thin-bedded limestone, with fewer or a lack of chert nodules; fossils such as gastropods are present. Thickness 500–>700m.

STRUCTURAL GEOLOGY

The Lower Pahranagat Lake NW quadrangle includes an area that underwent at least two deformations. The first was Cretaceous shortening during the Sevier orogeny and accompanying uplift of the Nevadaplano, a high orogenic plateau. The second was Oligocene–Miocene extension that is associated with normal-, oblique-, and strike-slip faults. Quaternary fault scarps are present in the region, but only a small part of a scarp is exposed at the southern edge of the quadrangle.

No major structures of the Sevier fold-and-thrust belt or associated central Nevada thrust belt are exposed in the quadrangle, just one small reverse fault in the north that offsets Paleozoic units. The Gass Peak and correlative Pahranagat thrusts may exist at depth; however, they are cut by younger structures and covered by either the Cretaceous–Tertiary sediments (conglomerates and freshwater limestone) or the Oligocene–Miocene units.

The Cretaceous–Tertiary sediments and the Oligocene–Miocene units unconformably overlie the Paleozoic units. The unconformity is angular, which suggests presence of Cretaceous shortening structures. In addition, the unconformity has a buttress geometry, which suggests that the Paleozoic units formed paleo-hills.

Oligocene and/or Miocene extension is evidenced by normal-, oblique-, and strike-slip faults. The majority of these faults cut all of the exposed tuffs suggesting that they are younger than the 14.7 Ma Kane Wash Tuff. However, a few faults cut through the 18.5 Ma Hiko Tuff and are covered by the Kane Wash Tuff, which suggests a minor post 18.5 Ma and pre-14.7 Ma faulting event.

The major post-14.7 Ma structures are part of the NE-striking, left-lateral Pahranagat 0 (a.k.a. Pahranagat fault system) (e.g., Tschanz and Pampeyan, 1970; Jayko, 2007). Parts of each of the three major left-lateral faults are exposed: the Arrowhead Mine fault in the north, the Buckhorn fault in the center, and the Maynard Lake fault in the south. Each of these faults transmits slip from NNE-, N-, and/or NNW-striking normal and oblique-slip faults, and thus, are transfer faults. These three faults together, form a zone of slip transfer.

Several E–W striking apparent normal faults and the Buckhorn syncline lie between the Buckhorn and Arrowhead Mine faults. The syncline is spatially closer to the Buckhorn fault than the Arrowhead Mine fault. This syncline plunges gently NE and is an open fold. Tuffs as young as the Kane Wash Tuff are folded suggesting Miocene, or younger, folding. This syncline and the E–W striking faults are interpreted to accommodate differential deformation in the rocks between the Arrowhead Mine and Buckhorn faults.

Small duplexes occur along the Arrowhead Mine and Maynard Lake faults. The duplex along the Arrowhead Mine fault is exposed in Oligocene–Miocene ash-flow tuffs. The duplex along the Maynard Lake fault contains both Oligocene–Miocene tuffs and highly faulted Ordovician–Devonian marine rocks. Each duplex occurs near a bend in a strike-slip fault, which suggests that the duplexes aid in accommodating changes in fault strike.

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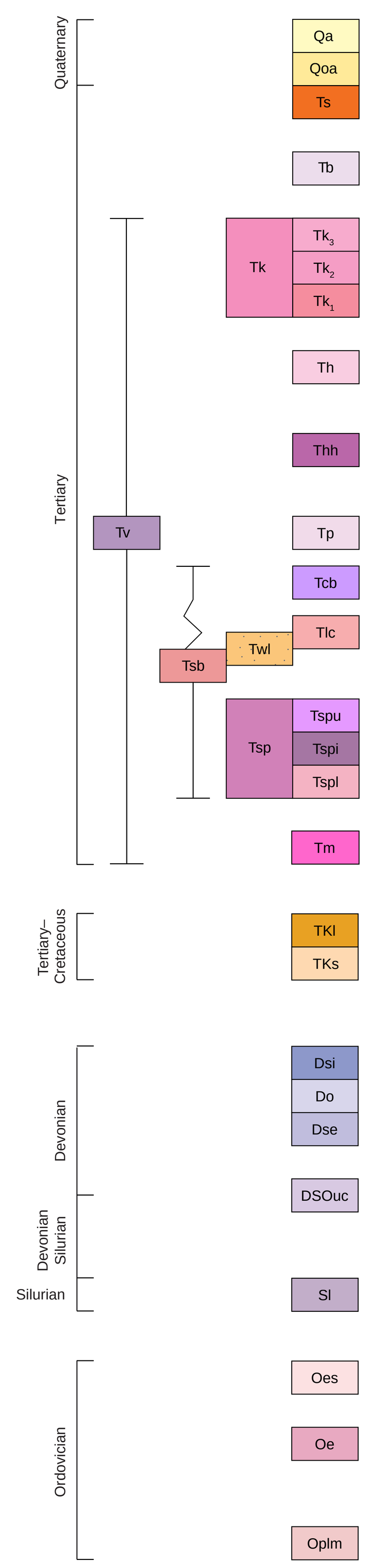

Contact Solid where certain and location accurate.

Fault Solid where certain and location accurate, dashed where approximately located, dotted where concealed.

35

Normal fault Solid where certain and location accurate, dashed where approximately located, dotted where concealed. Ball on downthrown side. Locally showing dip.

Strike-slip fault Solid where certain and location accurate, dashed where approximately located, dotted where concealed. Arrows show relative motion.

Oblique-slip fault Solid where certain and location accurate, dashed where approximately located, dotted where concealed. Ball on downthrown side. Arrows show relative motion.

Anticline Solid where certain and location accurate, dashed where approximately located, dotted where concealed. Arrow shows direction of plunge.

Syncline Solid where certain and location accurate, dashed where approximately located, dotted where concealed. Arrow shows direction of plunge.

Strike and dip of bedding

41 Inclined

Strike and dip of compaction foliation in ash-flow tuff

27 Inclined

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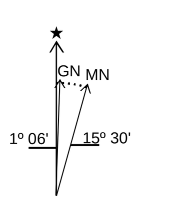
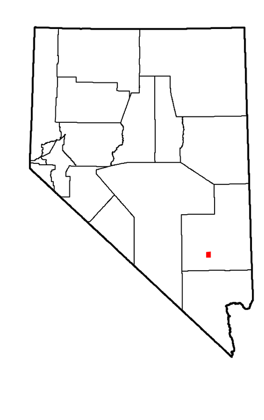


UTM GRID AND
1969 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET



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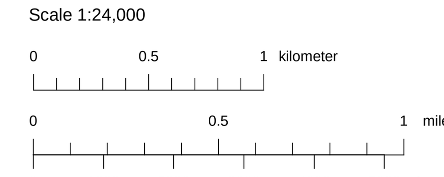
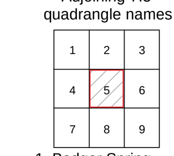


CONTOUR INTERVAL 40 FEET

Projection: Universal Transverse Mercator, Zone 11, North American Datum 1927 (m)

Base map: U.S. Geological Survey Lower Pahranagat Lake NW 7.5' quadrangle (1969)

Adjoining 7.5' quadrangle names



1 Badger Spring
2 Alamo
3 Alamo SE
4 Desert Hills NE
5 Lower Pahranagat Lake NW
6 Lower Pahranagat Lake
7 Desert Hills SE
8 Lower Pahranagat Lake SW
9 Lower Pahranagat Lake SE

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DRAFT
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Will be revised before publication

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