U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

PRELIMINARY GEOLOGIC MAP OF THE ARROW CANYON NW QUADRANGLE, CLARK COUNTY, NEVADA

By

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DESCRIPTION OF MAP UNITS

Descriptive colors for map units are from the Rock-Color Chart Committee (1951)

Qa **Modern alluvium (Holocene)**--Moderate yellowish brown to pale yellowish brown silt, sand, gravelly sand, and gravel; gravel and sand consist mostly of Paleozoic clasts derived from adjacent ranges; much of fine-grained alluvium is probably reworked eolian silt and sand. Unconsolidated to weakly consolidated, poorly sorted, and poorly to moderately bedded. Unit forms channel and floodplain deposits in active washes. In major valleys, northwest Hidden Valley (southwest part of quadrangle) and southern Coyote Spring Valley (north central part of quadrangle), channels contain mostly silt eroded from paludal deposit of map unit Qyz (see below), and minor sand and gravel; channel and floodplain surfaces are generally smooth. At and near range fronts, channel deposits consist mostly of coarser gravels and minor amounts of silt and sand; bar and swale topography is common; generally less than 3 m thick

Qc **Colluvium (Holocene and Pleistocene?)**--Unconsolidated to moderately consolidated talus and slope debris. Unit consists mostly of poorly sorted boulder-size clasts and minor silt and sand; generally nonbedded and locally cemented by secondary carbonate; unit located at base of steep slopes adjacent to and within ranges. Generally less than 10 m thick

Qls **Landslide deposit (Quaternary)**--Several slides are present in the southwest quarter of the quadrangle that involve rocks of the Indian Springs Formation and overlying Bird Spring Formation. Deposit consists mostly of coherent blocks but includes chaotic debris near shaly intervals at the base. Landslides are common in the Indian Springs due to presence of incompetent shale beds; sliding probably occurred during Pleistocene pluvial times when climatic conditions were wetter than present. Parent rock is shown in parentheses; about 40 m thick

Qyz **Paludal deposit (late Pleistocene)**--Calcareous silt, yellowish gray (fresh) and light yellowish gray (weathered), weakly consolidated, and moderately bedded. Unit located adjacent to and within the active wash of southern Coyote Spring Valley in the north central part of the quadrangle; forms small rounded bluffs, many of which are capped by thin gravel of map unit Qya (see below). Maximum exposed thickness about 2 m

Qya **Younger alluvium (upper Pleistocene)**--Pale yellowish brown to moderate yellowish brown silt, sand, and gravel, composed of subangular to subrounded Paleozoic clasts that are poorly to moderately sorted, poorly to moderately bedded, and weakly consolidated to unconsolidated. Clasts are slightly cemented by calcite and undercoated by a thin film of carbonate. Unit forms broad fans and stream terraces that generally stand 2 m above active washes; fan surfaces are moderately dissected and commonly contain boulder trains. Maximum exposed thickness about 3 m

Qia **Intermediate alluvium (upper and middle Pleistocene)**--Pale yellowish brown to moderate yellowish brown silt, sand, and gravel composed of Paleozoic clasts; poorly bedded, moderately sorted, and weakly consolidated. Under side of clasts have carbonate coatings that are several millimeters thick. Unit forms fans and fan remnants that commonly stand 2-3 m above active washes; fan surfaces are smooth and generally have loosely packed stone pavements in which many clasts show dark brown desert varnish. Maximum exposed thickness about 5 m

Qoa **Older alluvium (middle and early Pleistocene)**--Gravel and gravelly sand, poorly to moderately bedded, and well cemented by calcite. Unit forms fan remnants that generally stand 3 to 5 m above active washes; fan surfaces are smooth, have rounded edges, and a firm surface pavement in which many clasts show dark brown desert varnish. In places, fan tops are preserved by carbonate soil zones 1 to 2 m thick; at these locations, surface pavement consists of abundant carbonate soil fragments. Maximum exposed thickness about 7 m

Tls **Gravity-slide blocks and landslide debris (upper and middle Miocene?)**--Gravity-slide blocks consisting chiefly of brecciated Paleozoic rocks and landslide debris. In some slide blocks, the stratigraphic order of units is largely preserved despite being highly brecciated. Other slide blocks consist of chaotic mixtures of several stratigraphic units. Unit located in the southern half of quadrangle. Most sliding represented by unit was probably during or shortly following major episodes of extension in the region, about 15 Ma. Parent rock shown in parentheses; 20 to 40 m thick

Ths **Horse Spring Formation (middle and early Miocene)**--Synextensional basin-fill deposits composed mostly of calcareous sandstone. Unit designation as revised by Bohannon (1984) in the western Lake Mead area, about 40 to 50 km southeast of quadrangle, and as used by Maldonado and Schmidt (1991) in the southern Sheep Range area, about 30 to 40 km southeast of this quadrangle. Deposits are light brown to grayish orangish pink, friable, and mostly fine to coarse grained, but includes some very fine gravel-size clasts; very poorly sorted and thin bedded. In order of decreasing abundance, contains quartz, plagioclase, sanidine, hornblende, and biotite; also includes white carbonate nodules, subrounded Paleozoic limestone, dolomite and chert granules, and light-brown claystone lithics as large as 1 cm in diameter. Matrix consists of mixture of calcite, silt, and clay. Forms slope; maximum exposed thickness about 10 m. Present only in southeast corner of map along range front

Bird Spring Formation (Lower Permian, Pennsylvanian, and Upper Mississippian)--Subdivided everywhere into the following informal members in descending order; Bunker Hills, massive gray limestone, dolomitic, Tungsten Gap, and basal limestone. Maximum preserved cumulative thickness about 1,200 m; top not exposed in quadrangle

Pb5 **Bunker Hills member (Lower Permian)**--Consists mainly of alternating thinly-laminated beds of silty limestone, calcareous siltstone, and chert. Limestone is micritic, dark to olive gray (fresh), and very light gray to light olive gray and less commonly purplish gray (weathered); calcareous siltstone laminae tend to weather yellowish gray, dusky yellowish gray, and moderate brown. Chert is olive gray to olive black (fresh), and moderate brown to dusky yellowish brown (weathered). Rocks show abundant convolute bedding and are generally unfossiliferous although abundant sponge spicules are visible in thin section. Lowermost 60 m of member consists of pale-red, very thin bedded to thinly laminated silty limestone and calcareous siltstone, containing thin beds and lenses of medium-dark-gray, finely crystalline, planar-laminated limestone. Distinctive phosphatic concretions 0.5 to 4 cm in diameter are present at the base of member; concretions are commonly cored by fish bone fragments. Three bioclastic limestone ledges are exposed within the member; bioclasts consist mainly of pelmatozoan stem fragments and fusulinids. The uppermost two ledges consist mostly of matrix-supported limestone breccia composed of subrounded cobble to boulder size clasts of medium-gray bioclastic limestone that float in a silty, yellowish-gray, bioclastic matrix. The lowermost bioclastic limestone forms a 50 m thick massive ledge about 160 m above the base of member, and includes breccia clasts at its base and top. Unit is here named for a reference section in the Farrier quadrangle (Schmidt, 1994), Meadow Valley Mountains, 25 km northeast of this quadrangle; equivalent to unit d of Pampeyan (1993) for the Bird Spring Formation. Regional stratigraphic and sedimentological studies of member (Page, 1993) suggest that the laminated silty limestones, calcareous siltstones and chert represent slope facies rocks deposited on a carbonate slope separating a Lower Permian shelf margin to the east from an interior sea to the west. The bioclastic limestones are interpreted as submarine debris flow sheets containing shelf facies rocks that were transported eastward and deposited on the carbonate slope. Entire member forms pinkish-reddish-brown ledgy slope; preserved thickness about 380 m, top not exposed. Present only near northwest corner of quadrangle

Pb4 **Massive gray limestone member (Lower Permian)**--Predominantly massive cliff-forming limestone, dark gray (fresh) and medium-dark gray to light-olive gray (weathered), finely to coarsely crystalline, thick to very thick bedded. Contains some discontinuous layers and nodules of dusky-yellowish-brown-weathering chert. About 3 m below the top is a 10-m-thick interval of flaggy weathering, finely crystalline, very thin bedded, fusulinid-rich limestone that is medium gray (fresh) and grayish orange, light brown, moderate brown, and dusky yellowish brown (weathered). Includes basal 7-m-thick cherty limestone (commonly consisting of more than 40 percent chert) that is medium to medium-dark gray to grayish red (fresh), and light gray, pale red, and pinkish gray (weathered), aphanic to finely crystalline, and thin bedded. Member contains abundant fossils including *Durhamina* corals, *Syringapora* coral mounds, pelmatozoan stems, *Schwagerina* fusulinids, bryozoans, brachiopods, and planispiral gastropods. About 45 m thick; present only near northwest corner of quadrangle

PIPb3 **Dolomitic member (Lower Permian and Upper and Middle Pennsylvanian)**--Limestone, dolomitic limestone, and dolomite, medium-dark gray and olive gray to light-olive gray (fresh), and light-gray, yellowish-gray, light-olive gray, moderate-yellowish brown, and dusky-yellowish brown (weathered), finely crystalline, less commonly medium to coarsely crystalline, and thin to thick bedded. Fossils include pelmatozoan stems, colonial and solitary rugose corals, *Syringapora*, fusulinids, brachiopods, and bryozoans. Permian-Pennsylvanian contact estimated to be about 60-70 m above the base of member based on the stratigraphic position of fusulinids described by Cassity and Langenheim (1966). Member forms step-like ledges and is about 250 m thick

IPb2 **Tungsten Gap member (Middle Pennsylvanian)**--Member consists of silty dolomitic limestone, medium gray (fresh) and dusky-yellowish brown to moderate brown, yellowish gray, and grayish orange (weathered), finely crystalline, and thin bedded. Fossils include brachiopods and pelmatozoan stems. Member is distinctive due to heavy desert varnish on weathered surfaces, and serves as a prominent marker bed within the Bird Spring Formation in the region. Member is equivalent to the Tungsten Gap Chert (Castle, 1967; Langenheim and Webster, 1979) and is within unit Bs_C, Bird Spring Group, of Langenheim and others (1962). Forms resistant, rounded cliff about 15-25 m thick

[PMb1 **Basal limestone member (Middle Pennsylvanian to Upper Mississippian)**--Limestone and minor dolomite. Limestone is medium gray, medium dark gray, and olive gray (fresh), and light gray, yellowish gray, light olive gray, grayish orange to moderate yellowish brown (weathered), commonly arenaceous and bioclastic, finely to coarsely crystalline, thin to thick bedded; some beds contain planar laminations and small-scale trough crossbeds. Abundant discontinuous layers and nodules of dark-gray (fresh) and dusky-yellowish-brown (weathered) chert; some parts of member contain more than 50 percent chert. Several dolomite beds are present in the middle part of unit; dolomite is medium gray (fresh) and yellowish gray to light gray (weathered). Member contains *Syringapora*, solitary rugose corals, brachiopods, bryozoans, and pelmatozoan stems; *Chaetetes* and fusulinids present in upper part; also includes some oolitic limestone. Member equivalent to most of Bs_C unit, Bird Spring Group, of Langenheim and others (1962). Basal 14 m or so of member is reportedly Upper Mississippian (late Chesterian) in age based on brachiopods, conodonts, and calcareous foraminifers (Webster, 1969; Brenckle, 1973; Lane and others, 1983). Member forms step-like ledges and is estimated to be 500 m thick

Mis **Indian Springs Formation (Upper Mississippian)**--In order of decreasing abundance, consists of interbedded limestone, shale, and sandstone. Limestone is medium gray, grayish red, and moderate yellowish brown to grayish brown, fine to coarsely crystalline, and mostly thin bedded. Shale is dusky red, grayish red purple, grayish orange, and grayish black, and is mostly in the lower part of the formation. Sandstone, most abundant near the top of the formation, is olive gray to light gray (fresh) and moderate brown and moderate yellowish brown to dusky yellowish brown (weathered); composed of fine, subrounded, and moderately sorted quartz grains. Beds range from 0.5 to 1.0 m thick, and show planar laminations. Fossils include *Rhipidomella nevadensis*, spiriferid, and productid brachiopods, solitary rugose corals, pelmatozoan stems, and bryozoans; *Stigmaria* compressions are present at the base of the formation. Unit is equivalent to member Bs_b of the Bird Spring Group of Langenheim and others (1962), and is reportedly late Chesterian in age (Webster, 1969; Brenckle, 1973; Lane and others, 1983). Formation forms slopes and is approximately 60 m thick

Mbw **Battleship Wash Formation (Upper Mississippian)**--Consists of limestone and subordinate sandstone. Limestone is slightly arenaceous and bioclastic, medium dark gray (fresh) and light olive gray (weathered), mostly coarsely crystalline, and thin bedded. Basal 1.5 m of formation consists of sandstone and sandy limestone. Sandstone is calcareous, medium light gray (fresh) and grayish orange to olive gray (weathered), and thin bedded. Fossils in formation include *Faberophyllum* and other solitary rugose corals, and spiriferid brachiopods. Formation is equivalent to unit Bs_a of the Bird Spring Group of Langenheim and others (1962), and is latest Meramecian and early Chesterian in age (Brenckle, 1973; Lane and others, 1983; Poole and Sandberg, 1991). Formation forms ledgy cliffs and is about 80-100 m thick

Monte Cristo Group (Upper and Lower Mississippian)--Subdivided into, in descending order, Yellowpine Limestone, Bullion Limestone, Anchor Limestone, and Dawn Limestone. Thickness of group is as much as 500 m

Mmcy **Yellowpine Limestone (Upper Mississippian)**--Medium dark gray to dark gray (fresh) and medium light gray to light olive gray (weathered), medium crystalline, and mostly thick-bedded; contains sparse nodules of medium-dark-gray (fresh) and dusky-yellowish-brown (weathered) chert. Formation contains solitary rugose corals, colonial *Syringapora* mounds, and pelmatozoan stems, and a *Lithostrotionella* colonial coral biostrome marks the top of unit. Yellowpine forms massive cliffs and is about 80-100 m thick

Mmcb **Bullion Limestone (Lower Mississippian)**--Three parts are recognizable but were not mapped separately. Upper part is about 50 m thick, and consists of limestone, medium-dark-gray (fresh) light-gray to light-olive gray (weathered), finely to medium crystalline, and thick-bedded; contains discontinuous layers of dusky-yellowish-brown chert. Fossils include pelmatozoan stems and brachiopods. Middle part is about 100 m thick and consists of thin-bedded cherty limestone, medium-light gray (fresh) and medium-gray to light-olive gray (weathered), and mostly coarsely crystalline; commonly contains more than 60 percent chert. Chert is dark gray (fresh) and moderate brown to dusky yellowish brown (weathered) and occurs in beds 7-10 cm thick that have planar laminations and small-scale trough crossbeds; contains abundant pelmatozoan stems. Lower part, about 30 m thick, consists of relatively chert-free limestone, medium light-gray (fresh) and light-gray (weathered), mostly coarsely crystalline, and thick-bedded; contains abundant pelmatozoan stems and some solitary rugose corals. Formation forms massive cliffs and is about 180 m thick

Mmca **Anchor Limestone (Lower Mississippian)**--Alternating thin-bedded limestone and chert. Limestone is medium dark gray (fresh) and medium gray to light olive gray (weathered), and finely crystalline. Chert is smoky medium gray to medium light gray (fresh) and moderate yellowish brown to dusky yellowish brown (weathered), and thin bedded. Unit contains sparse brachiopods, pelmatozoan stems, and corals. Formation weathers to ledgy cliffs, and is about 140 m thick

Mmcd **Dawn Limestone (Lower Mississippian)**--Thin bedded, medium dark gray (fresh) and medium gray, medium light gray, and light olive gray (weathered), and aphanic to finely crystalline. Commonly contains elongate nodules and discontinuous layers of moderate-brown to dusky-yellowish-brown-weathering chert. Formation is very fossiliferous and contains abundant solitary rugose corals, *Lithostrotionella* corals, brachiopods, and pelmatozoan stems. Brenckle (1973) reported disconformity at lower contact with Crystal Pass Limestone based on foraminifers. Forms ledgy cliffs and is about 80 m thick

MDcp **Crystal Pass Limestone (Lower Mississippian and Upper Devonian)**--Medium-light gray (fresh) and light gray (weathered), mostly aphanic but locally finely crystalline, thin to thick bedded, and planar laminated; contains sparse gastropods. A 2.5-m-thick, laterally discontinuous, sandstone bed about 15-20 m below the top of formation may mark a regional unconformity between the lower Mississippian and Upper Devonian parts of the formation reported by Poole and Sandberg (1991). Forms massive cliffs, and is about 50-60 m thick

Guilmette Formation (Upper and Middle Devonian)--Subdivided into upper and lower informal members. Formation is 400-450 m thick

Dgu **Upper member (Upper and Middle Devonian)**--Limestone, dolomite, and sandstone. Upper part of member is limestone and interbedded sandstone. Limestone is medium light gray (fresh) and medium gray to light gray (weathered), aphanic to finely crystalline, and thin bedded and planar laminated; Fossils include brachiopods, gastropods, and stromatoporoids. Contains four quartzose sandstone beds in the upper part of the member; sandstone is pale yellowish brown to medium gray (fresh) and dusky yellowish brown to light brown (weathered); quartz grains are mostly medium, and less commonly fine and coarse, moderately well sorted, and subrounded to rounded; beds range from 15 to 30 cm thick and contain planar laminations and trough crossbeds. Lower 65 m of member is dolomite, dark-gray (fresh) and medium-gray to medium-dark gray (weathered), finely crystalline, and thin bedded; contains abundant stromatoporoids, common *Amphipora*, and gastropods. Member is equivalent to Arrow Canyon Formation of Langenheim and others (1962), and is about 320-340 m thick

Dgl **Lower member (Middle Devonian)**--Dolomite, and subordinate interbedded limestone. Dolomite is mostly light gray, light olive gray and olive gray (fresh) and yellowish gray (weathered), finely to medium crystalline, and thin to thick bedded; shows planar laminations, tepee structures and mud cracks. Less commonly contains beds of medium-dark-gray (fresh) and medium-light-gray to light-gray (weathered) coarsely crystalline dolomite. Limestone, more common near base, is olive gray to medium dark gray (fresh) and medium gray to medium light gray (weathered), mostly aphanic, and thin to thick bedded. Karst zones present near top of unit. Member is equivalent to Moapa Formation of Langenheim and others (1962), and to the "yellow bed" of Tschanz and Pampeyan (1970). Forms step-like ledges and is about 80-100 m thick

Dsi **Simonson Dolomite (Lower Devonian)**--Upper 13 m is biostromal dolomite, medium-dark gray to dark gray (fresh) and medium gray to light-olive gray (weathered), medium crystalline, and thin bedded. Biostromes consist of *Thamnopora*, brachiopods, and bulbous stromatoporoids; *Stringocephalus* brachiopods are present near the top, and a 0.6-m-thick quartzite bed is located at base of the biostromal dolomite. Most of the formation consists of alternating beds of yellowish-gray, medium- to dark-gray, commonly mottled yellowish gray, and light-olive-gray, slightly argillaceous, finely crystalline, and thin bedded dolomite, showing planar to wavy laminations, mudcracks, and convolute bedding. Basal 3-12 m of formation is quartzite, yellowish-gray (fresh) and dark yellowish brown, and moderate brown to brownish black (weathered); quartz grains are fine to very fine, subrounded, and moderately well sorted; contains hummocky cross-stratification. Formation equivalent to Piute Formation of Langenheim and others (1962). Forms ledgy slopes and is about 80-100 m thick

Sl **Laketown Dolomite (Silurian)**--Upper part is dolomite, medium gray (fresh) and medium-light gray to light-olive gray (weathered), and finely to coarsely crystalline, with sparse solitary corals and several encrinite beds. Middle part is unfossiliferous dolomite, medium gray to medium-light gray (fresh) and light gray to very light gray (weathered), and aphanic to finely crystalline; exhibits distinctive wavy algal laminations, and, near top of middle part, a 5-7-m-thick karst zone. Lower part is dolomite, medium-dark gray (fresh) and light-olive gray (weathered), finely crystalline, vuggy, and thin bedded, with distinctive light-gray-weathering planar and wavy laminations; also contains some ripple cross-bed sets about 2.5-cm-thick. Fossils include pelmatozoan stems, solitary cylindrical corals, and brachiopods. Forms cliffs and is 90-110 m thick

Oes **Ely Springs Dolomite (Upper Ordovician)**--Dolomite and subordinate sandstone. Upper part of formation, about 25 m thick, consists of dolomite, medium gray to medium-light gray (fresh) and light-olive gray to light gray (weathered) with splotchy light-gray mottles, and thin to thick bedded. Common zones of oncoids, and abundant pelmatozoan stem, brachiopod, and coral fragments. Upper part weathers lighter gray than the overlying Laketown Dolomite and underlying darker gray dolomite of the middle part of formation. Middle part, which is thickest part of formation (about 80 m thick), consists of dolomite, dark gray (fresh) and medium-dark gray (weathered), finely crystalline, and thin bedded, with common planar laminations; contains pelmatozoan stems, brachiopods, *Favosites*, and other colonial and solitary corals. A 10- to 15-m-thick cherty zone is present near the center of the middle part. Middle part forms massive cliff. Lower part, about 15 m thick, consists of medium-light-gray to light-gray bioclastic dolomite containing abundant pelmatozoan stem fragments and brachiopods. Lower part also contains interbeds of resistant moderate-brown to dusky-yellowish-brown arenaceous dolomite that is very thin bedded and trough-crossbedded. Below arenaceous dolomite is a thin zone of moderate-red to pale-red, thin-bedded to laminated, slightly calcareous shale, siltstone, and fine-grained sandstone. Lower part forms less resistant unit between overlying part of formation and the underlying Eureka quartzite. Formation is about 120 m thick

Oe **Eureka Quartzite (Middle Ordovician)**--Consists of quartzite and friable sandstone, white (fresh) and light brown, and moderate brown to dusky-yellowish brown (weathered); quartz grains are fine to medium, rounded to subrounded, and moderately well sorted. Formation is thin to thick bedded, and contains tabular planar crossbeds and less common trough crossbeds; crossbed sets average about 0.4 m thick; also contains *Skolithos* burrows. Forms rounded cliffs and is 40-50 m thick

Pogonip Group (Middle and Lower Ordovician)--Subdivided into Antelope Valley Limestone and Goodwin Limestone (Ross, 1964). Total thickness of Pogonip Group is estimated to be about 600 m

Opa **Antelope Valley Limestone** (Middle Ordovician)--Unit consists of five parts that total about 300 m in thickness: upper yellowish-gray-weathering slope former (80 m thick), upper dark-gray massive cliff former (60 m thick), middle brown-weathering slope former (80 m thick), lower dark-gray massive cliff former (30 m thick), and basal yellow-weathering slope former (50 m thick). **Uppermost slope former** consists of limestone and dolomite. Dolomite, present only in the uppermost 15 to 20 m, is dark gray (fresh), weathering to alternating shades of gray, finely to medium crystalline, and mostly thin bedded; contains yellowish-gray burrow mottles. Limestone in upper part is burrow mottled to pale red and grayish orange; mostly finely crystalline and micritic, with some interbedded coarsely crystalline bioclastic packstones; thin bedded to laminated. Micritic limestone is dark gray to olive gray (fresh) and light gray, very light gray, and grayish orange (weathered). Bioclastic packstones are generally dark gray (fresh and weathered), contain fragments of gastropods, trilobites, pelmatozoan stems, and brachiopods, and intraclasts, and commonly shows ripple cross stratification. Upper part also includes olive gray medium crystalline limestone that contains pale-red, grayish-orange, and yellowish-gray silty laminae. Near the base of upper part are abundant *Receptaculites*, *Palliseria*, and pale-red to grayish-orange oncoids. Equivalent to the upper Aycees Member of the Antelope Valley Limestone (Byers and others, 1961), the upper member of the Antelope Valley Limestone of Ross (1964, 1967, and 1970), and member Opf of the Pogonip Group (Langenheim and others, 1962). **Upper cliff former** is limestone, medium-dark gray, finely crystalline, and thick bedded; burrow-mottled to shades of grayish and yellowish orange; contains abundant pale-red to yellowish-orange oncoids, and *Maclurites* gastropods; *Receptaculites* present from the middle to the top. Equivalent to the lower Aycees Member of the Antelope Valley Limestone (Byers and others, 1961), the middle member of the Antelope Valley Limestone of Ross (1964, 1967, and 1970), and member Ope of the Pogonip Group (Langenheim and others, 1962). **Middle slope former** consists of thin-bedded to laminated, dark-brown to grayish-orange limestone, finely to medium crystalline, with dark-brown chert layers and abundant burrow trails on bedding planes; becomes more coarsely crystalline and fossiliferous upwards, with abundant solitary coral, pelmatozoan stem, and gastropod fragments, and yellowish-orange oncoids. Also includes some interbeds of medium-gray to light-olive-gray shale, grayish orange calcareous siltstone, and thin-bedded intraclastic limestone near the top. Equivalent to the lower Paiute Ridge Member and Ninemile Formation of the Antelope Valley Limestone (Byers and others, 1961), and member Opd of the Pogonip Group (Langenheim and others, 1962). **Lower cliff former** consists of regularly-bedded limestone, medium-dark gray (fresh) and light-olive gray to medium gray (weathered), and finely to medium crystalline; contains discontinuous dark-brown chert layers about 5 cm thick, and zones of yellowish-orange burrow

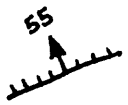
mottles that increase in density toward the top. Equivalent to part of the Ninemile Formation of the Antelope Valley Limestone (Byers and others 1961), and to member Opc of the Pogonip Group (Langenheim and others, 1962). **Lowermost slope former** consists of silty dolomite, light-olive gray to olive gray (fresh) and grayish orange to moderate-yellowish brown (weathered), mostly finely crystalline, and thin bedded; contains grayish orange wavy, silty laminae that show bioturbation. Equivalent to part of the Ninemile Formation of the Antelope Valley Limestone (Byers and others, 1961), and to member Opb of the Pogonip Group (Langenheim and others, 1962)

Opg **Goodwin Limestone** (Lower Ordovician)--Dolomite, medium-dark gray (fresh) and light-olive gray (weathered), mostly medium crystalline, and thick bedded; characteristically contains brown-weathering chert layers and nodules; also contains some intraclastic limestone. Includes basal 8-to-10-m-thick, yellowish-brown-weathering, thin-bedded limestone that is burrow mottled, and contains abundant beds of intraclastic limestone. Unit equivalent to member Opa of the Pogonip Group (Langenheim and others, 1962). Forms massive cliffs and is about 300 m thick

Ꞓn **Nopah Formation (Upper Cambrian)**--Dolomite, mostly dark gray (fresh) and olive black (weathered); less commonly medium-light gray (fresh) and light gray to light olive gray (weathered); lighter gray color commonly cuts across depositional boundaries, and is probably related to diagenetic alteration. Dolomite is medium crystalline and thin to thick bedded. Contains discontinuous layers and nodules of moderate-brown to dusky-yellowish-brown-weathering chert. Brachiopods and zones of trough cross-bedded oncoids are common. About 80-90 m below top of unit is a 35-m-thick dolomite interval that is lithologically similar to beds in the Pogonip Group; the dolomite is olive gray, dusky yellow, and medium gray (fresh), and yellowish gray to light-olive gray (weathered), finely crystalline, very thin bedded, and burrowed, with common grayish-orange to dark-yellowish-orange mottles. Grayish-red to dusky-red stylolites are diagnostic of this interval. Formation forms massive cliffs and only the uppermost 130 to 150 m of unit exposed in quadrangle; complete thickness estimated at 360 m (Page, 1992)

Contact

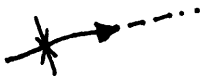
High-angle normal or reverse fault--Barbed arrow shows direction and amount of dip. Diamond-shaped arrow shows trend and plunge of slickenside lineation. Cross bar indicates vertical dip. Dashed where approximately located, dotted where concealed, queried where location is uncertain. Bar and ball on downthrown side



Fault-line scarp--Hachures on downthrown side where scarp is partially covered by onlapping surficial unit. Barbed arrow shows direction and amount of dip of fault plane

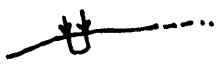
The following compressional structures, thrust faults, anticlines, synclines, and minor folds, formed during the Cretaceous Sevier Orogeny (Armstrong, 1968) in the foot wall of the Gass Peak Thrust Fault (Guth, 1990, 1980; Guth and others, 1988). The Gass Peak thrust is exposed less than 5 km to the west of this quadrangle in the Las Vegas Range.

Thrust fault--Sawteeth on upper plate. Dotted where concealed, queried where location is uncertain. Barbed arrow shows direction and amount of dip

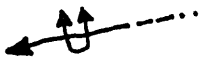


Syncline--Dashed where approximately located, dotted where concealed. Barbed arrow points in direction of plunge

Anticline--Dashed where approximately located, dotted where concealed, queried where location is uncertain



Overturned syncline--Dashed where approximately located, dotted where concealed



Overturned anticline--Dashed where approximately located, dotted where concealed. Barbed arrow points in direction of plunge

Minor fold--Barbed arrow points in direction of plunge

Low-angle slip surface beneath gravity-slide block--Sawteeth and stippled on upper plate

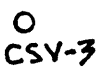
Strike and dip of beds

Inclined

Overturned

Horizontal

Breccia zones--breccia clasts are supported by a matrix of white to pinkish-gray coarsely crystalline calcite deposited by groundwater



Location of U.S. Geological Survey test well--From Berger and others (1988). Three other holes were drilled by the U.S. Geological Survey (Anderson and Jenkins, 1970) in the vicinity of CSV-3, but their locations could not be determined.

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