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

Prepared in cooperation
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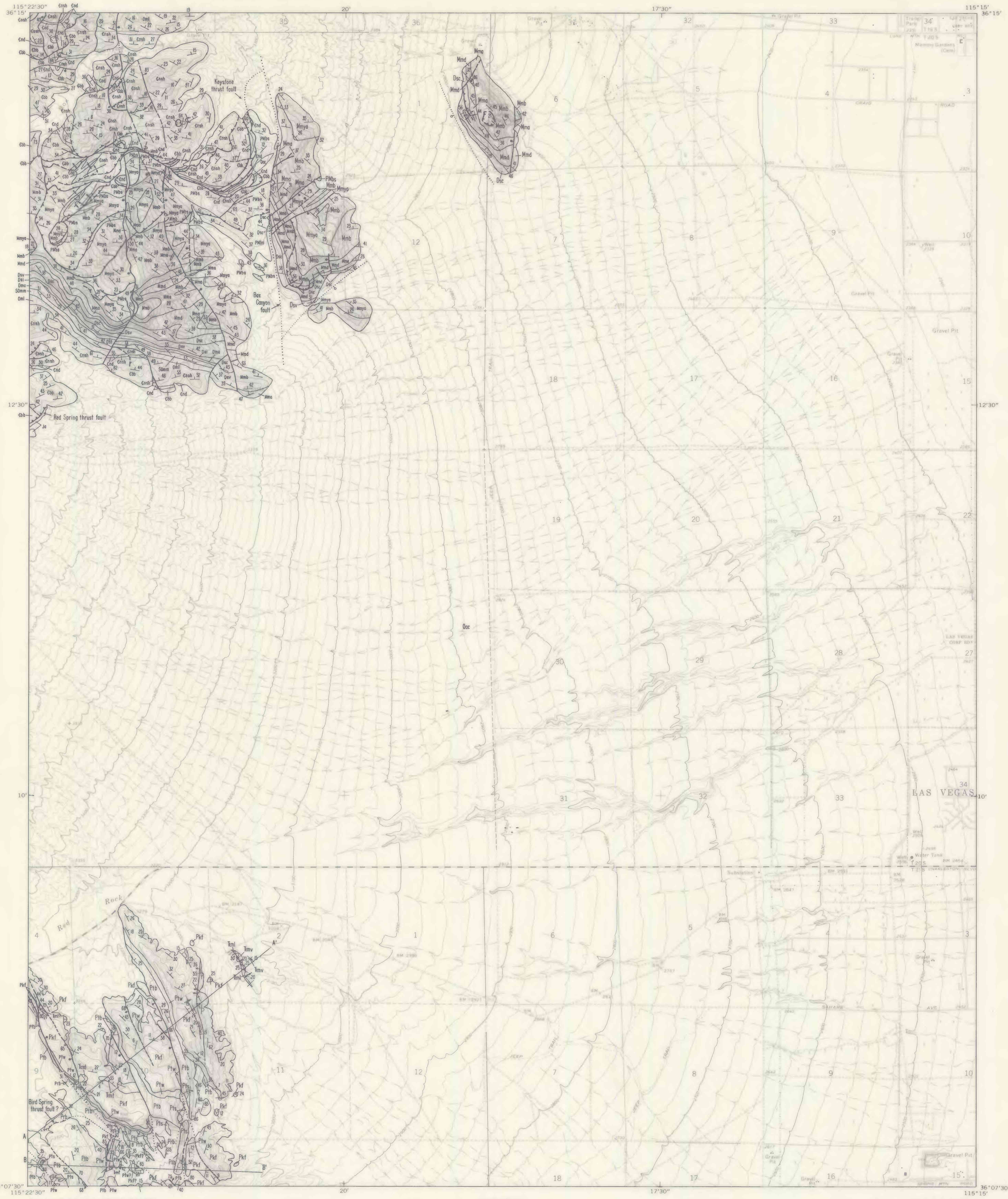
Nevada Bureau of Mines and Geology

OPEN-FILE REPORT
92-363



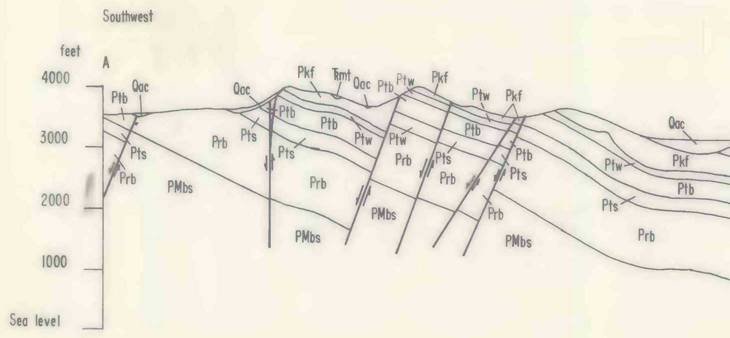
Base from U.S. Geological Survey, 1:24,000,
Blue Diamond NE, Nevada, 1972

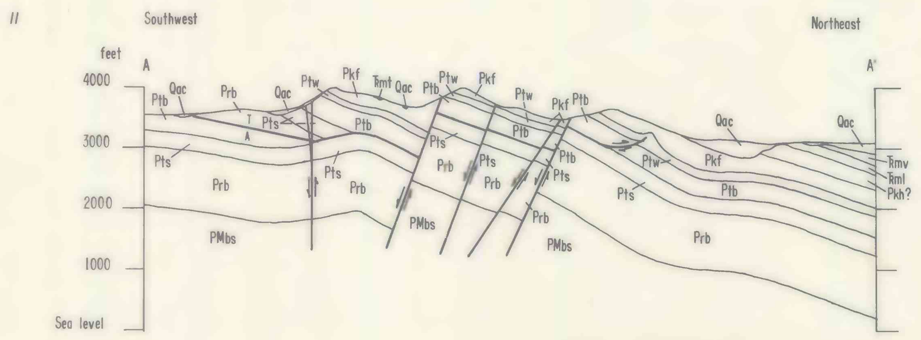
SCALE 1:24 000

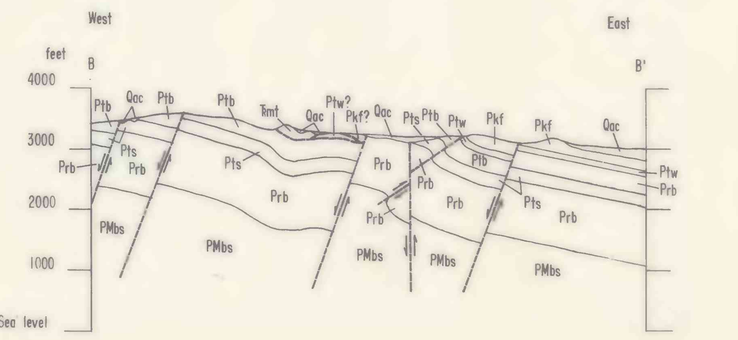
CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

QUADRANGLE LOCATION

Geology modified from Axen (1985)
and mapped in 1991 by M.D. Carr







BEDROCK GEOLOGIC MAP OF THE BLUE DIAMOND NE 7.5' QUADRANGLE, CLARK COUNTY, NEVADA

Compiled by

Michael D. Carr

1992

Menlo Park, California

CORRELATION OF MAP UNITS

- Qac — Quaternary
- Angular unconformity
- Ja — Jurassic
- Break in section interval not exposed
- Ŧmv, Ŧml, Ŧmt — Triassic
- Disconformity
- Pkf
- Disconformity
- Ptw, Ptb, Pts — Permian
- Disconformity
- Prb
- Disconformity
- PMbs — Permian to Mississippian
- Disconformity
- Mmya, Mmb, Mma, Mmd — Mississippian
- Paraconformity
- Dsc, Dsv, Dsi — Devonian
- Disconformity?
- Dmu
- Disconformity?
- SOmm — Silurian(?) and Ordovician
- Disconformity?
- Oml — Ordovician
- Ꞓnsh, Ꞓnd, Ꞓbb — Cambrian

DESCRIPTION OF MAP UNITS

Modified, in part, from Axen (1985) and Carr and McDonnell-Canan (1992)

Qac **Alluvial and colluvial deposits (Holocene and (or) Pleistocene)**--includes:

Modern alluvial and colluvial deposits (Holocene)--Pale-pink to pale-brown, unconsolidated fine to coarse sand, silt, and pebble to cobble gravel in incised active stream channels and on alluvial flats and colluvial surfaces. Calcium carbonate coatings on limestone and dolostone clasts. Stage I and II calcium carbonate soil horizons. Thickness 1 to 5 m

Young alluvial deposits (Holocene or Pleistocene)--Pale-pink to pale-brown or brownish-gray, unconsolidated to poorly consolidated fine to coarse sand, silt, and pebble to cobble gravel. Forms terraces. Scattered calcrete rubble litters terrace surfaces. Stage II to III calcium carbonate soil horizons. Thickness 1 to 8 m

Intermediate alluvial deposits (Pleistocene)--Pale-pink to pale- brown, poorly consolidated pebble to cobble gravel forms intermediate aged alluvial fans. Contains clasts of limestone, dolostone, and Aztec Sandstone with moderate desert varnish. Stage IV calcium carbonate soil horizon, 1.5 to 2 m thick, near fan surface. Continuous cover of calcrete rubble on fan surface. Thickness 5 to 20 m

Older alluvial deposits (Pleistocene)--Light-gray to pinkish-gray poorly consolidated pebble to cobble gravel forms oldest alluvial fans. Stage IV calcium carbonate soil horizon 3 m thick. Continuous cover of calcrete rubble on fan surface. Contains clasts of limestone, dolomite and subordinate Aztec Sandstone. Clasts are strongly etched. Thickness 10 to 50 m

Conglomerate of Brownstone Basin (Cretaceous?)--Well-rounded pebbles and cobbles of quartzite, limestone, dolostone, and chert, including sparse jasper, in matrix of quartz sand reworked from Aztec Sandstone. Cobbles as large as 10 cm. Locally, a vertical zonation from conglomerate containing as much as 50 percent clasts of carbonate rock derived from Paleozoic miogeoclinal strata in upper part to conglomerate containing only quartzite, gray chert, and jasper clasts in lower part Davis (1973). Conglomerate of Brownstone Basin not mapped separately in Blue Diamond NE quadrangle. Present only as discontinuous lenses resting disconformably on Aztec Sandstone and below Red Spring thrust fault at west edge of quadrangle, lat. 36°12'30" N. Thickness is 0 to 5 m

Ja **Aztec Sandstone (Jurassic)**--Very pale-orange to moderate-reddish-brown eolian quartz sandstone with large festoon cross beds. Sandstone is well sorted, with subangular to rounded grains less than 0.5 mm in diameter. Calcite and (or) iron oxide cement. Cross-bed sets are as thick as 10 m and as long as 25 m. Foreset laminae 0.5 to 2 cm thick. Irregular coloring crosses primary depositional features. Moderately resistant and forms cliffs where outcrops are more extensive than in Blue Diamond NE quadrangle. Upper contact in this area is Red Spring thrust fault; lower contact not exposed in quadrangle. Minimum thickness 665 m estimated in La Madre Mountain area (Axen, 1985)

Moenkopi Formation (Triassic)--Upper part, including upper red, Shnabkaib, and middle red members, not exposed in Blue Diamond NE quadrangle. Part of Moenkopi Formation that is exposed in quadrangle divided into:

Ŧmv **Virgin Limestone Member**--Pale-yellowish-brown to yellowish-gray, moderately well-bedded, micritic limestone. Contains beds of oolitic, stylolitic, algal, stromatolitic, and (or) skeletal limestone, dolostone, gypsum, siltstone, and fine-grained sandstone. Forms ledges and slopes. Top not exposed in quadrangle. Thickness of complete unit 110 m measured in next quadrangle to south (Carr and McDonnell-Canan, 1992)

Ŧml **Lower red member**--Very-pale-orange to grayish-yellow, interbedded shale, siltstone, micritic limestone, and sparse gypsiferous siltstone. Beds generally less than 20 cm thick. Forms slopes. Lower part not exposed in quadrangle. Thickness of complete unit 52 m measured in next quadrangle to south (Carr and McDonnell-Canan, 1992)

Ŧmt **Timpoweap Member**--Dark-gray to reddish-brown, pebble to cobble conglomerate. Contains subangular to rounded clasts of limestone and chert derived from Kaibab Formation, along with sparse clasts of red calcareous sandstone. Mostly massive and poorly bedded. Locally contains intervals or lenses of well-bedded pebble conglomerate and coarse sandstone in which beds are internally massive, parallel laminated, or cross laminated. Forms resistant outcrops. Top of unit not exposed in quadrangle. Basal contact is disconformity. Member is laterally discontinuous; fills erosional channels, generally cut into Fossil Mountain Member of Kaibab Formation. At south edge of map, Timpoweap Member rests on units as old as Brady Canyon Member of Toroweap Formation along faulted contact. Fault follows base of Timpoweap Member, however, and may have resulted mearly from layer-parallel slip along original depositional contact at base of unusually deep erosional channel. Partial thickness 50 m

Kaibab Formation (Permian)--Harrisburg Member forms upper part of formation in adjacent areas but is missing at unconformity where contact between Kaibab and Moenkopi Formations exposed in southwest part of this quadrangle. Exposed lower part of formation assigned to:

Pkf **Fossil Mountain Member**--Light-gray, yellowish-gray, and medium-gray, massive limestone and dolomitic limestone. Contains abundant moderate-brown-weathering nodules of very-light-gray chert. Poorly to moderately bedded; medium to thick beds. Chert nodules form more than 50 percent of rock in some intervals. Commonly contains brachiopods, bryozoans, algal mats, and algal limestone. Locally contains sparse, thin, discontinuous lenses of gypsum. Forms cliffs and ledges. Maximum thickness 75 m

Toroweap Formation (Permian)--Divided into:

Ptw **Woods Ranch Member**--Pale-yellowish-brown siltstone with thin veinlets and layers of white gypsym. Contains thin beds of pale-orange to light brown shale, siltstone, and dolomicrite. Poorly exposed; weathers to pale-red slopes. Thickness 30 m

Ptb **Brady Canyon Member**--Light-gray, yellowish-gray, and pinkish-gray, massive, micritic limestone, dolomitic limestone, and dolomicrite. Some intervals contain abundant pale-yellowish-brown to dark-yellowish-brown chert nodules. Poorly bedded; moderate to thick beds. Some beds contain fragments of brachiopods and pelecypods. Forms ridges and cliffs. Thickness 67 m

Pts **Seligman Member**--Pale-orange, light-brown, and orangish-gray mottled, medium- to thick-bedded, fine-grained quartz sandstone forms upper 5 m. Grades downward into pale-yellowish-brown, massive, gypsiferous siltstone. Poorly exposed, weathers to pale red-slopes. Thickness 60 m

Prb **Red beds (Permian)**--Moderate-orange-pink, light-brown, very-pale-orange, and pale-yellowish-orange, fine-grained sandstone. Moderately well- to well-bedded; thin to thick beds; massive, parallel-laminated, or cross-laminated. Forms slopes and weak ledges. Base not exposed in quadrangle. Thickness of complete unit 305 m in adjacent quadrangle (Carr and McDonnell-Canan, 1992)

PMbs **Bird Spring Formation (Permian to Mississippian)**--Light- to medium-brownish-gray interbedded micrite, fusulinid limestone, sandy limestone, dolostone, and silty limestone. Irregular layers of chert as much as 1 m thick and chert nodules common in and between some beds of carbonate rock. Well bedded; thin to thick beds. Fossils common in some beds and commonly are silicified. Forms ledges and cliffs. Upper part not exposed in quadrangle. Lowermost 5 to 10 m consists of thinly interbedded, pale-red sandstone, shale, and limestone; forms slopes. Conformable basal contact with Monte Cristo Limestone mapped at base of distinctive bed of pale-red limestone containing abundant calcite-filled vugs approximately 0.5 cm in diameter. Estimated thickness of partial section in northwest part of quadrangle 775+ m

Monte Cristo Limestone (Mississippian)--Divided into:

Mmya **Yellow Pine and Arrowhead Members, undivided**--Yellow Pine Member: Thick, massive beds of dark-gray, medium- to coarse-grained limestone. Contains abundant large rugose corals. Colonial corals and other fossil debris common in some beds. Beds rarely cross laminated. Uppermost part locally contains sparse 8-to-15-cm nodules of dark gray to black chert. Forms cliffs. Approximate thickness is 30 m. Arrowhead Member: Recessive interval consisting of 3-to-10-cm-thick beds of light-gray micritic limestone separated by silty parting as thick as 3 cm. Thickness 2 to 4 m

Mmb **Bullion Member**--Light-gray, medium- to coarse-grained, massive limestone and secondary dolostone. Nonbedded to poorly bedded; thick beds. Poorly fossiliferous. Forms cliffs. One or two beds of light-yellowish-orange chert commonly form an interval 1.5 m thick about 10 m below top of unit. Approximate thickness 130 m

Mma **Anchor Member**--Dark- to medium-gray, medium- to coarse-grained, skeletal limestone. Moderately well bedded; beds 0.5 to 4 m thick. Abundant chert nodules, 3 to 10 cm thick and 15 to 100 cm long, and chert layers as thick as 10 cm. Chert is light yellowish orange, pale blue, and grayish black; forms as much as 50 percent of rock in some intervals. Forms cliffs. Approximate thickness 80 m

Mmd **Dawn Member**--Dark- to medium-gray, medium- to coarse-grained, skeletal limestone. Moderately well bedded; beds 0.5 to 4 m thick. Sparse cross-laminated beds. Contains abundant crinoid, brachiopod, and gastropod debris. Large solitary corals locally common. Rare chert nodules. Basal contact is abruptly gradational and appears conformable with Sultan Limestone. Approximate thickness 50 m

Sultan Limestone (Devonian)--Divided into:

Dsc **Crystal Pass Member**--Light-gray, laminated, aphanitic limestone. Splits into thin plates. Locally contains algal mounds 7 to 15 cm in diameter. Forms steep cliffs. Approximate thickness 50 m

Dsv **Valentine Member**--Light- to dark-gray, fine- to coarse-grained limestone and dolostone. Light-gray limestone similar to that forming the Crystal Pass Member predominates in upper part; Medium- to dark-gray, coarse-grained dolostone predominant in lower part. Generally well bedded. Thin-bedded in upper part and thicker bedded, but not more than 4 m, in lower part. Locally contains beds of intraformational breccia. Contains sparse beds of sandy dolostone consisting of as much as 50 percent quartz grains, 0.5 to 1 mm in diameter. Forms cliffs. Approximate thickness 115 m

Dsi **Ironside Member**--Dark-gray, medium- to coarse-grained dolostone. Nonbedded to poorly bedded; thick beds. Contains abundant silicified stromatoporids, as much as 10 cm in diameter, which weather to moderate brown and dark yellowish brown. Commonly contains vugs filled with white, coarsely crystalline dolomite. Basal contact is gradational and conformable with Mountain Springs Formation. Contact located at base of lowest prominent stromatoporoid-bearing dolostone bed. Thickness 3 to 15 m

Mountain Springs Formation

Dmu **Upper part (Devonian)**--Dark-gray, medium- to coarse-grained dolostone. Nonbedded to poorly bedded; thick beds. Commonly contains vugs filled with white, coarsely crystalline dolomite. Basal contact with middle part of Mountain Springs Formation probably a disconformity. Thickness 45 m

SOmm **Middle part (Silurian? and Ordovician)**--Very-pale-orange to moderate-orange-pink silty dolostone and rare silty limestone. Commonly contains laminations and irregular partings of moderate brown siltstone. Forms slopes. Basal contact with lower part of Mountain Springs Formation probably a disconformity. Thickness 50 m

Oml **Lower part (Ordovician)**--Medium- to light-gray, fine- to coarse-grained dolostone and rare limestone. Thin- to medium-bedded. Commonly contains pale-blue to bluish-white chert nodules, about 1 cm thick, 5 cm wide, and 15 cm long. Sparse glauconite, intraclasts, and ooids locally present. Forms narrow, sloping ledges above massive cliffs made by upper part of Nopah Formation. Basal contact with Nopah Formation conformable; contact poorly exposed but apparently is sharp. Thickness 70 m

Nopah Formation (Cambrian)

Ꞓnsh **Smoky and Halfpint Members**--Light-gray to very-light-gray, medium-grained, massive dolostone with sugary weathering surfaces. Nonbedded to poorly bedded; thick beds. Locally contains poorly preserved cross beds or algal mounds, but generally primary structures are obliterated by dolomitization. Algal nodules (Osagia) common in lowermost 10 m. Forms blocky cliffs. Thickness 300 m

Ꞓnd **Dunderberg Shale Member**--Upper half consists of moderate-yellowish-brown silty dolostone interbedded with olive-gray shale. Well bedded; 0.5-to-1-m thick beds. Dolostone beds commonly contain rip-up clasts. Osagia common near top. Lower half consists of medium-gray, coarse-grained limestone interbedded with olive-gray shale. Well bedded; 0.5-to-1-m-thick beds. Limestone beds commonly contain abundant trilobite debris and (or) rip-up clasts. Forms slopes. Basal contact with Bonanza King Formation is conformable. Approximate thickness 25 m

Bonanza King Formation (Cambrian)

Ꞓbb **Banded Mountain Member**--Uppermost part is light-gray to very-light-gray, medium-grained, massive dolostone with sugary weathering surfaces. Nonbedded to poorly bedded; medium to thick beds. Contains sparse chert nodules. Overlies interval of light- to dark-gray, fine- to medium-grained dolomicrite, which locally contains small pellets that give rock a peppery appearance. Overlies alternating intervals of (1) dark-gray to grayish-black dolostone mottled with brownish gray, (2) medium-gray dolomite with medium- to dark-bluish-gray chert nodules, and (3) light- to dark-gray dolomicrite forming alternating color bands 1 to 4 m thick. An interval of light-brown silty dolomite forms the lowermost 15 m of unit. Lower half to two thirds of Banded Mountain Member are missing above Red Spring thrust fault; Keystone thrust fault cuts near, but generally above, silty unit forming lowermost part of member (Burchfiel and others, 1982; Axen, 1985). Basal contact is a thrust fault everywhere in quadrangle. Thickness of partial section 445+ m

Contact--Nearly all contacts shown by Axen (1981) in Blue Diamond NE quadrangle were designated as approximate. Contacts in southwest part of quadrangle plotted using a PG-2 plotter. Bedrock-bedrock contacts are definite, whereas most alluvium-bedrock contacts are approximate. No graphic distinction is made here between definite and approximate contacts

Fault--Dashed where inferred, dotted where concealed. Arrow and number indicate dip direction and dip of fault plane. Apparent vertical displacement indicated by bar and ball on downthrown side. Slip directions generally not known. In geologic sections, arrows indicate apparent movement in plane of section. "T" indicates movement toward viewer; "A" indicates movement away from viewer

Thrust fault--Barbs on upper plate

Folds--Showing trace of axial plane. Dashed where inferred, dotted where concealed

Anticline

Overturned anticline

Syncline

Overturned syncline

Monocline--Arrowhead on more steeply dipping limb

Strike and dip of beds

15 **Inclined**

75 **Overturned**

DISCUSSION

The Blue Diamond NE 7.5' quadrangle is situated at the western edge of Las Vegas, Nevada, covering the easternmost part of the northern Spring Mountains and adjacent parts of Las Vegas Valley (fig. 1). The landscape is dominated by a broad alluvial fan. Drainage is from the west, originating in the Spring Mountains. Red Rock Wash, a major intermittent drainage, passes through the southwest part of the quadrangle and continues southeastward into the northeast part of the Blue Diamond SE quadrangle, posing a flash flood hazard for the parts of Las Vegas that are in its path. Bedrock is exposed in the mountainous terrain in the northwest part of the quadrangle, which is the easternmost extension of the northern Spring Mountains. The isolated bedrock hill of Lone Mountain is a landmark in the north-central part of the quadrangle. A series of low ridges in the southwest part of the quadrangle also expose bedrock.

The present map was compiled, in part, from mapping by Axen (1985) that covers the part of the Spring Mountains in the northwest corner of the quadrangle, as well as Lone Mountain. Data were transferred by inspection to the scale-stable topographic base materials used for the present compilation. New mapping of the bedrock hills in the southwest part of the quadrangle was done by M.D. Carr on 1:31,680-scale natural color aerial photographs (U.S. Bureau of Land Management Project N-05 FY76). Data were transferred to scale-stable topographic base materials using a Kern PG-2 plotter.

Coverage of the Blue Diamond NE quadrangle was contained on a geologic map by Glock (1929, fig.2), who described the general stratigraphy and structure of the northern Spring Mountains. Glock's mapping also served as the principal coverage of the Blue Diamond area for a regional geologic map compilation by Longwell and others (1965). Longwell (1926) previously had discussed the geologic framework of the northern Spring Mountains based on a reconnaissance study of southern Nevada. Longwell described the relations between the Keystone and Red Springs thrust plates in the northeastern Spring Mountains, which are partly covered by the quadrangle. More recently, Davis (1973) mapped in the Red Springs area (west of the present quadrangle), further refining the structural relations between the Keystone and Red Springs thrust plates. Axen (1985) mapped the La Madre Mountain area (fig. 1) at an approximate scale of 1:24,000, providing the first coverage of bedrock in the Blue Diamond NE quadrangle since Glock (1929) and a partial basis for the present compilation. Surficial deposits in the Blue Diamond NE quadrangle were mapped by McDonnell-Canan (1989), but are not divided on the present map.

The bedrock units recognized in the Blue Diamond NE quadrangle are correlated, for the most part, with stratigraphy defined in the southern Great Basin/Mojave Desert region and on the Colorado Plateau (table 1). The allochthonous sections in the Red Spring and Keystone thrust plates in the northwest part of the quadrangle were described by Axen (1985). They consist of Cambrian through Permian carbonate rocks deposited on the western continental shelf of ancient North America in a depositional setting transitional between the cratonic platform and inner continental margin (miogeocline). Cambrian rocks are divided into the members of the Bonanza King and Nopah Formations (table 1). Departing slightly from the terminology, but not the mapped units, of Axen (1985), Ordovician, Silurian(?), and Devonian rocks are divided here into informal units described in terms of the Mountain Spring Formation as expanded by Miller and Zilinsky (1981), rather than the Pogonip Group(?) and originally defined Mountain Springs Formation of Gans (1974) . Younger Devonian through Permian units follow the stratigraphic nomenclature defined by Hewett (1931) in the southern Spring Mountains.

The autochthonous or parautochthonous section in the southwest part of the quadrangle consists of Permian and Triassic shallow marine carbonate rocks, fine-grained clastic rocks, and evaporites, as well as non-marine red beds, consisting of shale, sandstone, and sparse conglomerate, all deposited along the western margin of the North American cratonic platform. These strata are mapped herein as the Permian red beds of Longwell and others (1965) and members of the Toroweap, Kaibab, and Moenkopi Formations (table 1). The Jurassic Aztec Sandstone (Hewett, 1931) forms the only part of the autochthonous or parautochthonous section (lower plate of the Red Spring thrust) that is exposed in the northwest part of the Blue Diamond NE quadrangle.

Geologic structures in the northwest part of the Blue Diamond NE quadrangle are extensions of structures in the La Madre Mountain area of the northeastern Spring Mountains. The reader is referred to Axen (1985) for a more detailed discussion and interpretations of this geology in that broader context. The following brief discussion of this area is mostly abstracted from Axen (1985). The bedrock in the northwest part of the quadrangle is exposed in two thrust plates--the Red Spring and Keystone thrust plates. The Red Spring thrust fault carries rocks as old as the Banded Mountain Member of the Lower Cambrian Bonanza King Formation over autochthonous or parautochthonous rocks as young as the Jurassic Aztec Sandstone. Thin lenses of Cretaceous(?) synorogenic conglomerate, called the Red Spring conglomerate by Davis (1973) and the conglomerate of Brownstone Basin by Axen (1985), are present locally above the Aztec Sandstone and below the Red Spring thrust fault. One such lens of conglomerate was shown by Axen (1985) below the Red Spring thrust fault in the exposure at the west edge of the Blue Diamond NE quadrangle. The Keystone thrust fault places the same units as in the Red Spring thrust plate over rocks as young as the Mississippian Monte Cristo Limestone and the Permian through Mississippian Bird Spring Formation, forming the uppermost part of the Red Spring thrust plate. The diversity in the ages of the youngest units beneath the Keystone thrust fault from place to place is a result of faulting of the Red Spring thrust plate prior to emplacement of the Keystone thrust plate. Some of the steeply dipping faults that cut the Red Spring thrust plate are tear faults that formed above the Red Spring thrust fault. They do not cut the Red Spring thrust surface and are truncated by the Keystone thrust fault. Other steeply dipping faults in the La.Madre Mountain area offset the Red Spring thrust surface. The separation on these faults is greater in the Red Spring thrust plate than in the Keystone plate, indicating that at least some of the displacement predated emplacement of the Keystone thrust plate. Because the Red Spring thrust fault is exposed only in the westernmost part of the Blue Diamond NE quadrangle, it is not possible to determine the relationship between the Red Spring thrust surface and every one of the faults that cut the Red Spring thrust plate. Consequently, many of the faults cannot be classified demonstrably with respect to these two types of steeply dipping faults. Other steeply dipping faults in the quadrangle, such as the Box Canyon fault of Axen (1985) and possibly the inferred fault west of Lone Mountain, apparently offset both the Red Spring and Keystone thrust plates and, thus, are younger than the Keystone thrust fault. It is not known whether these particular faults also moved prior to the Keystone thrust faulting event, because the relative amounts of separation of the Red Spring and Keystone thrust plates cannot be determined for the faults. Both the Red Spring and Keystone thrust faults are thought to be Cretaceous in age based on isotopic dates from the region (see Fleck and Carr, 1990 for a discussion and recent data).

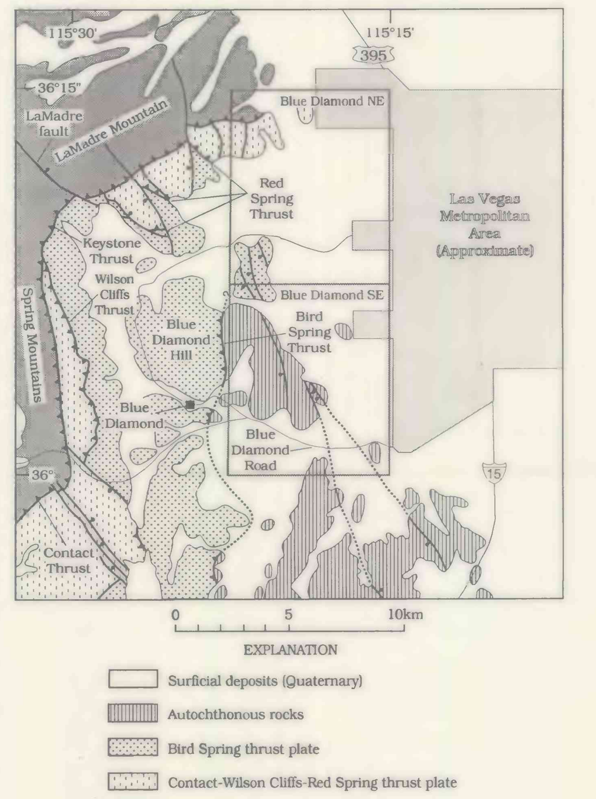


Figure 1. Generalized geologic map of northern Spring Mountains and Las Vegas Valley showing location of Blue Diamond NE 7.5' quadrangle. Modified after Longwell and others (1965).

The geology of the southwest part of the quadrangle is an extension of that of Blue Diamond Hill to the west and the Blue Diamond SE quadrangle (Carr and McDonnell-Canan, 1992) to the south. The most conspicuous structures in the southwest part of the quadrangle are the north-northwest-striking, mostly southwest-dipping, steep faults that cut the Permian and Triassic rocks into several eastward-tilted structural blocks. The largest of these faults have dip separations of 150 to 300 m (500 to 1000 ft). Slip directions are not known. The Permian and Triassic strata had already been deformed by Mesozoic folding and thrust faulting prior to being tilted further along the steeply dipping faults.

Eastward-vergent folds and fold-thrust structures are present in several of the structural blocks. These structures variously are monoclines with steep or steeply overturned eastern limbs, eastward-overturned anticline-syncline pairs, or overturned folds with small displacement thrust faults in their hinge areas. Assuming the simplest reconstruction of these structures removing the effects of the steeply dipping faults, the fold segments restore into a single anticline-syncline pair. Locally, there is disharmonic folding and minor thrust faulting of the Fossil Mountain Member of the Kaibab Formation (E.½'s. secs. 3 and 10) and the Brady Canyon Member of the Toroweap Formation (S.E.¼, sec 9 and S.W.¼, sec 10). Apparently, the gypsiferous units (Woods Ranch and Seligman Members of the Toroweap Formation) below each of these two competent carbonate rock units acted as zones of detachment, allowing disharmonic strain in the carbonate rocks.

Two interpretations of geologic section A-A' are presented herein. The first assumes that all of the concealed structural discontinuities, including the fault in the S.E.¼, sec. 9, T. 21 S., R. 59 E. labeled Bird Spring thrust fault (?), are steeply dipping normal or oblique-slip faults. In the second interpretation of section A-A', the inferred fault in the S.E.¼, sec. 9 is depicted as a northeastward continuation of the Bird Spring thrust fault from the eastern slope of Blue Diamond Hill (fig. 1). If this is a correct interpretation, then the Bird Spring thrust fault looses displacement northeastward and dies out into the eastward vergent folds in the southwest part of the Blue Diamond NE quadrangle. Both geologic sections honor surface geology, but current information is insufficient to validate uniquely either of the interpretations. Additional mapping to the west and southwest of the quadrangle might test the thrust fault interpretation. The steeply dipping faults in the southwest corner of the Blue Diamond NE quadrangle offset and, therefore, postdate the fold-thrust structures in the Permian and Triassic rocks. Although their relations to the Red Spring and Keystone thrust faults are not known, these steep faults do cut the autochthonous or parautochthonous lower plate of the Red Spring thrust fault and probably belong to the network of north- to northwest-striking, steeply dipping faults that cut the Red Spring and Keystone thrust faults, such as the La Madre and Box Canyon faults (fig.1; also see Axen, 1985).

Several small gypsum prospects are present in the Woods Ranch Member of the Toroweap Formation exposed in the southwest part of the quadrangle. Gravel has been excavated from the Quaternary alluvial fan deposits locally on the outskirts of Las Vegas.

ACKNOWLEDGMENTS

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Table 1. Stratigraphic nommenclature of bedrock units used in the Blue Diamond NE quadrangle.

Unit name	Type area	Reference
Aztec Sandstone	Goodsprings, Nev.	Hewett, 1931
Moenkopi Formation	Grand Canyon, Ariz.	Ward (1901)[5]
Upper part[1]	none	informal usage in this report
Virgin Limestone Mbr.	Washington Co., Utah	Bassler and Reeside (1921)
Lower red member	Zion Nat'l Mon., Utah	Gregory and Williams (1947)
Timpoweap Member	Zion Nat'l Mon., Utah	Gregory and Williams (1947)
Kaibab Formation	Kaibab Plateau, Ariz.	Darton (1910), McKee (1937)
Harrisburg Member	Washington Co., Utah	Bassler and Reeside (1921)
Fossil Mountain Member	Coconino Co., Ariz.	Sorauf (1963)[6]
Toroweap Formation	Mohave Co., Ariz.	McKee (1937)
Woods Ranch Member	Mohave Co., Ariz.	Sorauf (1963)[6]
Brady Canyon Member	Mohave Co., Ariz.	Sorauf (1963)[6]
Seligman Member	Coconino Co., Ariz.	Sorauf (1963)[6]
Red beds	none	Longwell and others (1965)
Bird Spring Formation	Goodsprings, Nev.	Hewett, 1931
Monte Cristo Limestone	Goodsprings, Nev.	Hewett, 1931
Yellow Pine	Goodsprings, Nev.	Hewett, 1931
Arrowhead Member	Goodsprings, Nev.	Hewett, 1931
Bullion Member	Goodsprings, Nev.	Hewett, 1931
Anchor Member	Goodsprings, Nev.	Hewett, 1931
Dawn Member	Goodsprings, Nev.	Hewett, 1931
Sultan Limestone	Goodsprings, Nev.	Hewett, 1931
Crystal Pass Member	Goodsprings, Nev.	Hewett, 1931
Valentine Member	Goodsprings, Nev.	Hewett, 1931
Ironside Member	Goodsprings, Nev.	Hewett, 1931
Mountain Springs Fm.	Spring Mts., Nev.	Gans, 1974; Miller and Zilinsky, 1981
Upper part[2]	none	informal usage in this report
Middle part[3]	none	informal usage in this report
Lower part[4]	none	informal usage in this report
Nopah Formation	Nopah Range, Calif.	Hazzard, 1937
Smoky Member	Nevada Test Site	Barnes and Palmer, 1961; Christiansen and Barnes, 1966
Halfpint Member	Nevada Test Site	Christiansen and Barnes, 1966
Dunderberg Shale Mbr.	Eureka district, Nev.	Walcot, 1908
Bonanza King Formation	Providence Mts., Calif.	Hazzard and Mason, 1936
Banded Mountain Mbr.	Nevada Test Site	Barnes and Palmer, 1961

[1] Includes upper red member of Gregory and Williams (1947), Shnabkaib shale member (Bassler and Reeside, 1921) and middle red member of Gregory and Williams (1947) undivided.

[2] Equivalent to unit 4 of the Mountain Springs Formation as defined by Miller and Zilinsky (1981)

[3] Equivalent to unit 3 of the Mountain Springs Formation as defined by Miller and Zilinsky (1981)

[4] Equivalent to units 1 and 2 of the expanded Mountain Springs Formation of Miller and Zilinsky (1981)

5See also Stewart and others (1972)

[6] See also Sorauf and Billingsley (1991)