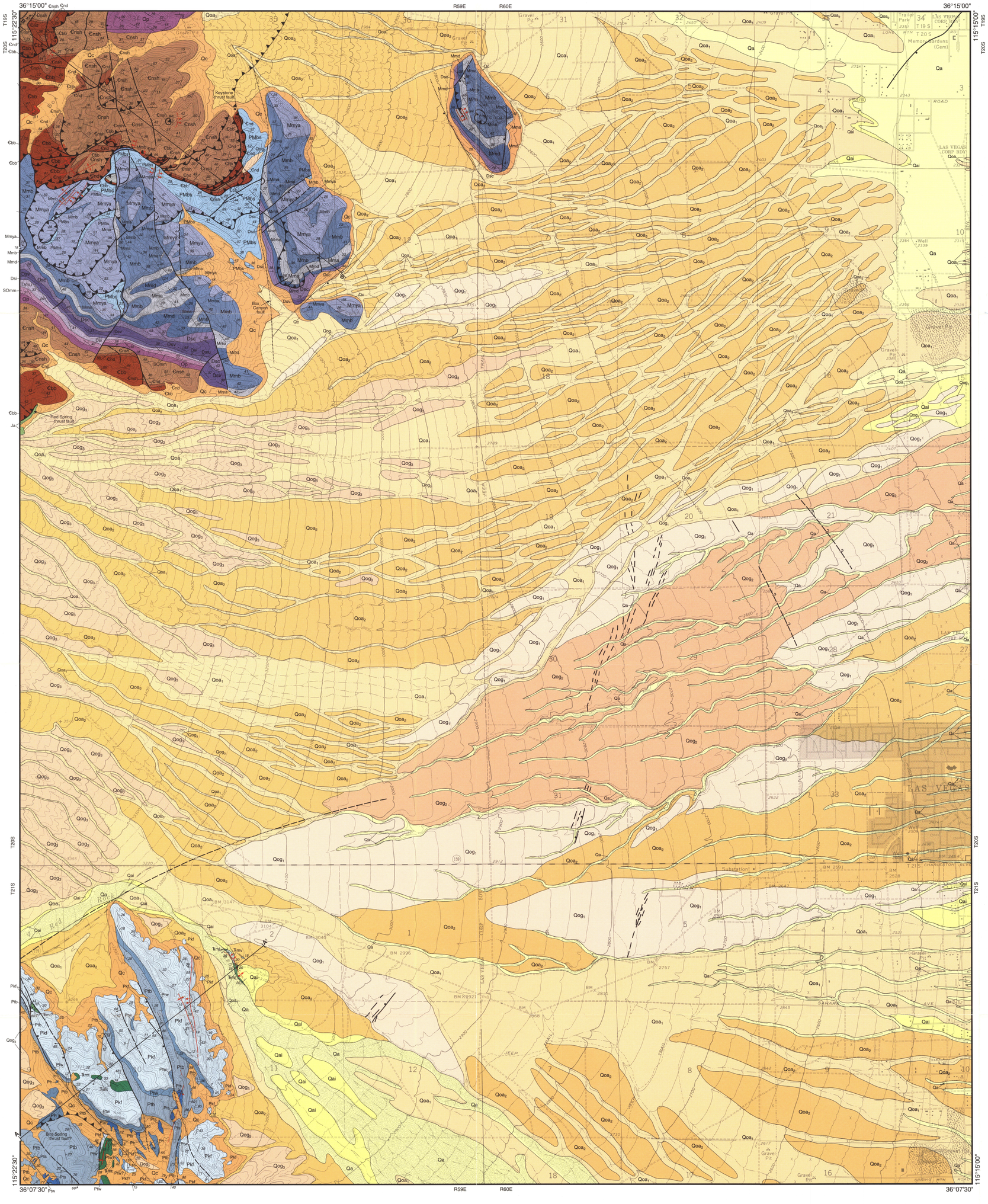

GEOLOGIC MAP OF THE BLUE DIAMOND NE QUADRANGLE, NEVADA

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2000

Surficial Deposits

Qa **Alluvium of active washes (Holocene)** Pink to pale-brown sand to pebble to cobble gravel occurring in incised active stream channels; unconsolidated to surficially cemented by calcium carbonate (case hardened). Clast composition is dominantly limestone and dolomite with subordinate quartzite. Sand-size sediment is primarily quartz; fragmental limestone, dolomite, and feldspar are subordinate. Deposits are typically veneers in wash bottoms and subject to flooding. Thickness ranges from 1 to 5 m.

Qai **Intermittently active alluvium (Holocene)** Pink to pale-brown sand and pebble to cobble gravel that occurs primarily on between-channel alluvial flats and less commonly in incised washes, slightly to moderately consolidated. Deposits are lithologically similar to Qa and grade laterally into Qa. Contains sediment transported and deposited during high-water or heavy flood discharges. Thickness ranges from 1 to 5 m.

Qc **Colluvium (age indeterminate)** Weathered material transported by gravity. Pink to brown sand, pebble to cobble gravel, and petrocalcic (calcrete) fragments that occur as thin veneers on slopes; unconsolidated to slightly consolidated material recycled from exposed bedrock units and from older alluvial and colluvial deposits; subject to reworking by wind and sheetwash. Thickness ranges from1 to10 m.

Qoa_1, Qoa_2 **Older alluvium of the Blue Diamond and Red Rock fans (late and middle Pleistocene)** Slightly to well dissected, moderately to well consolidated to locally cemented; petrocalcic carbonate horizon (calcrete) 1.5-2 m thick occurs at or near the surface. Clast composition is mainly limestone and dolomite with subordinate quartzite and sandstone. Surface of the unit is flat and smooth; displays a shallow, braided drainage pattern; has a well developed desert pavement; and is mottled on air photographs. This unit is divided into two terrace levels with slight topographic and surface morphology differences. **Qoa_1**: desert pavement contains abundant Aztec Sandstone clasts; correlates with Unit Qsp_4 on Tule Springs Quadrangle. **Qoa_2**: desert pavement contains few Aztec Sandstone clasts; correlates with Unit Qsp_2 on Tule Springs Quadrangle. Thickness ranges from 10 to 50 m.

Qog_1, Qog_2, Qog_3 **Older gravel deposits of the Blue Diamond and Red Rock fans (Pleistocene/Pliocene)** Consolidated to strongly cemented gravel deposits that represent early-generation alluvial fan development. Clasts consist mainly of limestone and dolomite with subordinate quartzite and sandstone. At the surface, carbonate clasts are strongly etched and broken and possess slight to moderate petrocalcic coatings; the petrocalcic horizon is eroded and petrocalcic fragments comprise varying proportions of the surface clasts. **Qog_1**: Light-gray to pink-brown, imbricated clast-supported pebble to cobble gravel capped by a matrix supported petrocalcic (calcrete) horizon 1 to 5 m thick at or near the surface. Deposits contain A-B soil horizons. Surface of the deposit is flat and smooth; displays an incised, dendritic drainage; and contains a well-developed desert pavement. Surficial unit as mapped represents the top of a fanglomerate and channel depositional sequence that is at least 270 m thick, based on the Las Vegas Valley Water District Well #78 (M. Johnson, personal commun.,July 1992). **Qog_2**: Light-gray to medium-brown, imbricated clast-supported pebble to cobble gravel, capped by a petrocalcic (calcrete) horizon 1.5-2 m thick near or at the surface. Lithology is the same as Qogl, except the A-B soil horizons have been removed by erosion. **Qog_3**: Light- to medium-brown, pebble to boulder gravel, capped by a petrocalcic (calcrete) horizon more than 2 m thick. Surface of the deposit displays ballena topography, parallel drainage, and contains a well-developed desert pavement. The petrocalcic (calcrete) horizons are eroding and petrocalcic fragments form the largest proportion of the surface clasts. Thickness ranges from 20 to 60 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 the Blue Diamond SE Quadrangle. Upper contact in this area is the Red Spring thrust fault; lower contact not exposed in quadrangle. Minimum thickness is 665 m estimated in La Madre Mountain area.

Moenkopi Formation (Triassic)

Upper part, including Upper Red, Shnabkaib, and Middle Red Members, is not exposed in the Blue Diamond NE Quadrangle. The part of the Moenkopi Formation that is exposed in the quadrangle is divided into the following members:

Ŧmv **Virgin Limestone Member** Pale-yellowish-brown to yellowish-gray, moderately well-bedded, micritic limestone. Contains beds of oolitic, stylolitic, cryptomicrobial, stromatolitic, and/or bioclastic limestone, dolomite, gypsum, siltstone, and fine-grained sandstone. Forms ledges and slopes. Top is not exposed in quadrangle. Thickness of complete unit is 110m as measured in next quadrangle to the south.

Ŧml **Lower Red Member** Very pale-orange to grayish-yellow, interbedded shale, siltstone, micritic limestone, and sparse gypsiferous siltstone. Beds are generally less than 20 cm thick. Forms slopes. Lower part is not exposed in quadrangle. Thickness of complete unit is 52 m as measured in the next quadrangle to the south.

Ŧmt **Timpoweap Member** Dark-gray to reddish-brown pebble to cobble conglomerate. Contains rounded clasts of limestone and chert derived from the 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 is not exposed in quadrangle. Basal contact is a disconformity. Member is laterally discontinuous; fills erosional channels, generally cuts into the Fossil Mountain Member of Kaibab Formation. Approximate thickness is 40 m.

Kaibab Formation (Permian)

Harrisburg Member forms the upper part of the formation in adjacent areas, but is missing at unconformity where the contact between Kaibab and Moenkopi Formations is exposed in the southwest part of this quadrangle. The exposed lower part of the formation is assigned to:

Pkh **Harrisburg Member** Light gray, tan, cream colored, dolomicrite and cherty dolomicrite, dolomitic limestone, bedded gypsum, and gypsiferous red beds (shale and claystone) in lowermost part. The Harrisburg Member of the Kaibab Formation is not mapped separately in the Blue Diamond NE Quadrangle. Contact is not exposed in the quadrangle, but lies beneath older gravel deposits of the Blue Diamond and Red Rock fans (Qog_3) in the southwestern portion of the quadrangle, latitude 36°07'30"N. Maximum thickness is 75 m.

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% of rock in some intervals. Commonly contains brachiopods, bryozoans, crinoids, and microbial limestone. Locally contains sparse, thin, discontinuous lenses of gypsum. Forms cliffs and ledges. Maximum thickness is 75 m.

Toroweap Formation (Permian)

Ptw **Woods Ranch Member** Pale-yellowish-brown siltstone with thin veinlets and layers of white gypsum. Contains thin beds of pale-orange to light-brown shale, siltstone, and dolomicrite. Poorly exposed; weathers to pale-red slopes. Approximate thickness is 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. Approximate thickness is 100 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. Approximate thickness is 60 m.

Ph **Hermit Formation (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 is 305 m in the Blue Diamond SE Quadrangle.

PMbs **Bird Springs Formation (Permian to Mississippian)** Light- to medium-grayish-brown, 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 of carbonate rock. Well bedded; thin to thick beds. Fossils are commonly silicified. Forms ledges and cliffs. Upper part is 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 the 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 northwestern part of quadrangle is 375+ m.

Monte Cristo Limestone (Mississippian)

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. Tabulate 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 is 130 m.

Mma **Anchor Member** Dark- to medium-gray, medium- to coarse-grained, bioclastic 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% of rock in some intervals. Forms cliffs. Approximate thickness is 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 rugose corals locally common; rare chert nodules. Basal contact is abruptly gradational and appears conformable with Sultan Limestone. Approximate thickness is 50 m.

Sultan Limestone (Devonian)

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 is 75 m.

Dsv **Valentine Member** Medium- to dark-gray, coarse dolostone. Thick- bedded, but not more than 4 m. Locally contains beds of intraformational breccia. Contains sparse beds of sandy dolostone consisting of as much as 50% quartz grains, 0.5 to 1 mm in diameter. Forms cliffs. Approximate thickness is 95 m.

Dsi **Ironside Member** Dark-gray, medium- to coarse-grained dolostone. Nonbedded to poorly bedded; thick beds. Contains abundant silicified stromatoporids, as large 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 stromatoporid-bearing dolostone bed. Thickness is 3 to 15 m.

Mountain Springs Formation (Devonian/Silurian/Ordovician)

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 the Mountain Springs Formation, probably a disconformity. Approximate thickness is 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. Approximate thickness is 50 m.

Op **Pogonip Group** Light- to medium-gray and orange-weathering, thinly to medium bedded, fine- to medium-crystalline dolostone and silty dolostone. Slope forming. Locally contains prominent black and bluish chert nodules and lenses up to several centimeters in diameter or in thickness and brown silicified algal mounds 10 to 15 cm in diameter. Unit is distinguished from the blocky and broken cliff forming Nopah Formation by its slope forming and orange-weathering silty lithologies. Lower contact is not exposed but is apparently sharp and marked by a change from slope-forming strata of the Pogonip Group to the cliff- and ledge-forming Nopah Formation below (Axen, 1985). Total unit thickness in the adjacent La Madre Mountain area is about 100 m (Axen, 1985).

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 microbial mounds, but generally primary structures are obliterated by dolomitization. Algal nodules (Osagia) common in the lowermost 10 m. Forms blocky cliffs. Approximate thickness is 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 1.0 m-thick beds. Dolostone beds commonly contain rip-up clasts. Osagia common near the 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. Basal contact with the Bonanza King Formation is conformable. Approximate thickness is 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 dolomite, which locally contains small pellets that give the 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 the unit. Lower two-thirds of Banded Mountain Member is missing above the Red Springs thrust fault; Keystone thrust fault cuts near, but generally above, silty unit forming lowermost part of member. Basal contact is a thrust fault everywhere in the quadrangle. Thickness of partial section is 445+ m.

Lithologic contact

Fault Dashed where inferred, dotted where inferred beneath alluvial cover. Arrow and number indicate measured dip direction and dip of fault surface. Ball on downthrown side.

Thrust fault Dashed where inferred, dotted where concealed, teeth on upper plate.

Syncline axial trace Dotted where concealed.

Anticline axial trace Dotted where concealed.

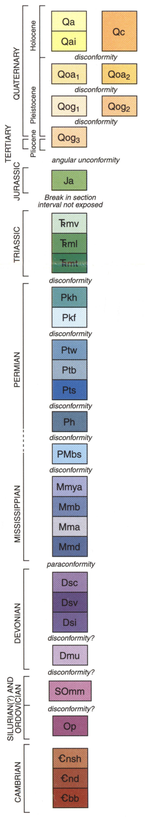
Overturned anticline

Overturned syncline

Monocline Arrowhead on more steeeply dipping limb.

Strike and dip of bedding

20 Inclined 64 Overturned



Scale 1:24,000

0 0.5 1 kilometer

0 0.5 1 mile

0 1000 2000 3000 4000 5000 feet

CONTOUR INTERVAL 20 FEET

Base map: U.S. Geological Survey
Blue Diamond NE 7.5' Quadrangle, 1983

References

Axen, G.J., 1985, Geologic map and description of structure and stratigraphy, La Madre Mountain, Spring Mountains, Nevada: Geological Society of America Map and Chart Series MC-51, 17p., 1 pl.

Bachman, G.O., and Machette, M.N., 1977, Calcic soils and calcretes in the southwestern United States: U.S. Geological Survey Open-File Report 77-794, 163 p.

Barnes, H., and Palmer, A.R., 1961, Revision of stratigraphic nomenclature of Cambrian rocks, Nevada Test Site and vicinity: U.S. Geological Survey Professional Paper424-C, p. C100-C103.

Bassler, H., and Reeside, J.B., Jr., 1921, Oil prospects in Washington County, Utah: U.S. Geological Survey Bulletin 726-C, p. 87-107.

Burchfiel, B.C., Fleck, R.J., Secor, D.T., Vincelette, R.R., and Davis, G.A., 1974, Geology of the Spring Mountains, Nevada: Geological Society of America Bulletin, v. 85, p. 1013-1022.

Burchfiel, B.C., Wernicke, B.P., Willemin, J.H., Axen, G.J., and Cameron, C.S., 1982, A new type of decollement thrusting: Nature, v. 300, p. 513-515.

Burchfiel, B.C., and Davis, G.A., 1988, Mesozoic thrust faults and Cenozoic low-angle faults,Eastern Spring Mountains, Nevada, and Clark Mountains Thrust Complex, California; *in* Weide, D.L., and Faber, M.L., eds., This Extended Land, Geological Journeys in the Southern Basin and Range: Geological Society of America, Cordilleran Section, Field Trip Guidebook, p. 87-106.

Carr, M.D., and McDonnell-Canan, C., 1992, Bedrock geologic map of the Blue Diamond SE Quadrangle, Clark County, Nevada: U.S. Geological Survey Open-file Report 92-177, 1:24,000.

Christensen, G.E., and Purcell, C., 1985, Correlation and age of Quaternary geology of the southwestern United States; *in* Weide, D.L., and Faber, M.L., eds. Soils and Quaternary geology of the southwestern United States: Geological Society of America Special Paper 203,p. 115-122.

Christiansen, R.L., and Barnes, H., 1966, Three members of the Upper Cambrian Nopah Formation in the southern Great Basin: U.S. Geological Survey Bulletin 1244-A, p.A49-A52.

Darton, N.H., 1910, A reconnaissance of parts of northwestern New Mexico and northern Arizona: U.S. Geological Survey Bulletin 435, 88 p.

Davis, G.A., 1973, Relations between the Keystone and Red Spring thrust faults, eastern Spring Mountains, Nevada: Geological Society of America Bulletin, v. 84, p. 3709-3716.

Fleck, R.J., and Carr, M.D., 1990, The age of the Keystone thrust: Laser fusion $^{40}Ar/^{39}Ar$ dating of foreland basin deposits, southern Spring Mountains: Tectonics, v. 9, p. 467-476.

Gans, W.T., 1974, Correlation and redefinition of the Goodsprings Dolomite, southern Nevada, and southeastern California: Geological Society of America Bulletin, v. 85, p.189200.

Gardner, L.R., 1972, Origin of Mormon Mesa caliche, Clark County, Nevada: Geological Society of America Bulletin, v. 83, p. 143-156.

Glock, W.S., 1929, Geology of the east-central part of the Spring Mountain range, Nevada: American Journal of Science, 5th series, v. 17, p. 326-341.

Gregory, H.E., and Williams, N.C., 1947, Zion National Monument, Utah: Geological Society of America Bulletin, v. 58, p. 211-244.

Hazzard, J.C., and Mason, J.F., 1936, Middle Cambrian Formations of the Providence and Marble Mountains, California: Geological Society of America Bulletin, v. 47, p. 220-240.

Hazzard, J.C., 1937, Paleozoic section in the Nopah and Resting Springs Mountains, Inyo County, California: California Division of Mines and Geology Bulletin, v. 33, p. 273-339.

Hewett, D.F., 1931, Geology and ore deposits of the Goodsprings Quadrangle, Nevada: U.S. Geological Survey Professional Paper 162, 172 p.

Lattman, L.H., 1973, Calcium carbonate cementation of alluvial fans in southern Nevada: Geological Society of America Bulletin, v. 84, p. 3013-3028.

Longwell, C.R., Pampeyan E.H., Bowyer, B., and Roberts, R.J., 1965, Geology and mineral deposits of Clark County, Nevada: Nevada Bureau of Mines and Geology Bulletin 62, 177 p.

Machette, M.N., 1985, Calcic soils of the southwestern United States; *in* Weide, D.L., and Faber, M.L., eds., Soils and Quaternary geology of the southwestern United States: Geological Society of America Special Paper 203, p. 1-21.

McDonnell-Canan, C., 1989, Morphology and development of the Red Rock Canyon alluvial fan, Clark County, Nevada [M.S. thesis]: University of Nevada, Las Vegas.

McKee, E.D., 1937, Research on middle Permian strata of the Grand Canyon National Park: Carnegie Institute Washington Yearbook 36, p. 341-343.

Miller, R.H., and Zilinsky, G.A., 1981, Lower Ordovician through Lower Devonian cratonic margin rocks of the southern Great Basin: Geological Society of America Bulletin, v. 92, p. 255-261.

Sorauf, J.E., 1963, Structural geology and stratigraphy of the Whitmore area, Mohave County, Arizona: Dissertation Abstracts, v. 24, p. 702.

Sorauf, J.E., and Billingsley, G.H., 1991, Members of the Toroweap and Kaibab Formations, Lower Permian, northern Arizona and southwestern Utah: The Mountain Geologist, The Rocky Mountain Association of Geologists, v. 28, p. 9-24.

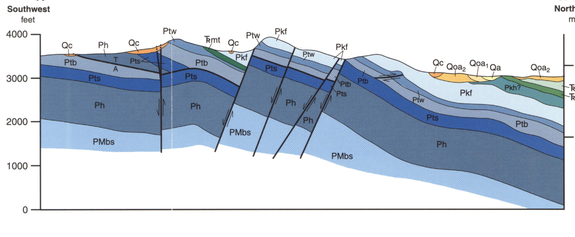
Sowers, J.M., 1985, Pedogenic calcretes of the Kyle Canyon alluvial fan: [Ph.D. thesis]: University of California, Berkeley, 159 p.

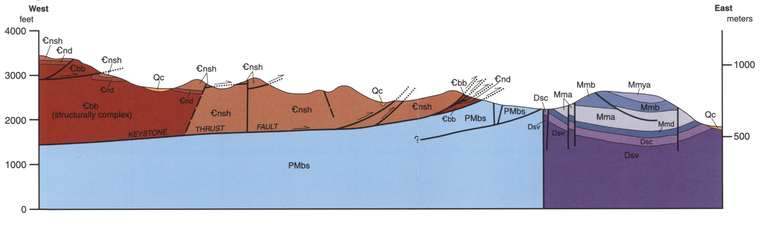
Sowers, J.M., Reheis, M.C., and McFadden, L.D., 1988, Rates of pedogenic calcium carbonate accumulation in limestone-derived soils of the Kyle Canyon alluvial fan preliminary data; *in* Weide, D.L., and Faber, M.L., eds., This Extended Land, Geological Journeys in the Southern Basin and Range: Geological Society of America, Cordilleran Section, Field Trip Guidebook, p. 28-32.

Stewart, J.H., Poole, F.G., and Wilson, R.F., 1972, Stratigraphy and origin of the Moenkopi Formation and related strata in the Colorado Plateau region: U.S. Geological Survey Professional Paper 691, 195 p.

Walcott, C.D., 1908, Cambrian sections of the Cordilleran area: Smithsonian Miscellaneous Collections, v. 53, p. 166-230.

Ward, L.F., 1901, Geology of the Little Colorado Valley: American Journal of Science, 4th Series, v. 12, p. 401-413.





Field work done from 1984 to 1997.

Field Review by: John Bell (NBMG), and Stephen Castor (NBMG)

Office Review by: John Bell (NBMG), Stephen Castor (NBMG), and Stephen Rowland (University of Nevada, Las Vegas)

First Edition, first printing 2000
Printed by Bear Industries, Sparks, NV
Edited by Dick Meeuwig
Cartography by Robert Chaney

Geologic mapping was supported by the University of Nevada, Las Vegas, Department of Geoscience.

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