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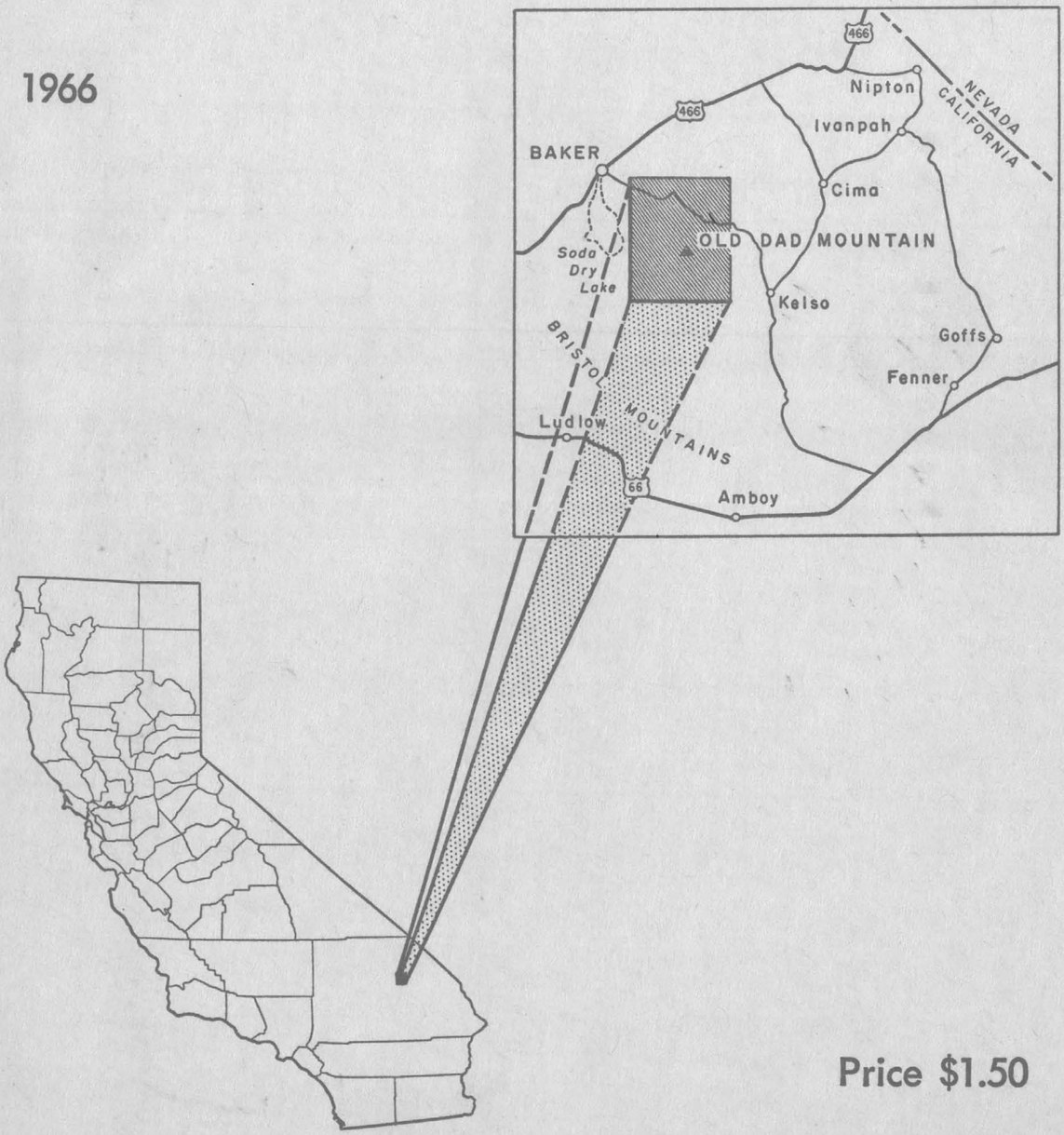
OLD DAD MOUNTAIN QUADRANGLE, SAN BERNARDINO COUNTY, CALIFORNIA
MAP SHEET 7

Geology of the northern part of Old Dad Mountain Quadrangle, San Bernardino County, California

By RICHARD A. BARCA

1966



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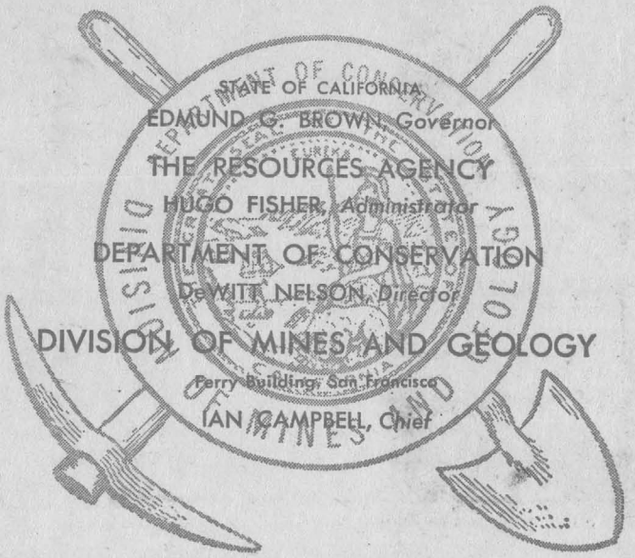

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GEOLOGY OF THE NORTHERN PART OF OLD DAD MOUNTAIN QUADRANGLE, SAN BERNARDINO COUNTY, CALIFORNIA

MAP SHEET 7
CALIFORNIA DIVISION OF MINES AND GEOLOGY
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GEOLOGY OF THE NORTHERN PART OF OLD DAD MOUNTAIN QUADRANGLE, SAN BERNARDINO COUNTY, CALIFORNIA

By Richard A. Barca

Abstracted from a thesis prepared in partial fulfillment of the requirements for the degree of Master of Arts, Department of Geology, University of Southern California, Los Angeles, 1960.
Manuscript submitted for publication 1960.

Old Dad Mountain 15-minute quadrangle is in the Mojave Desert region of southeastern California about 14 miles southeast of Baker, San Bernardino County. Approximately the north half of the quadrangle was mapped.

Field mapping was done intermittently between mid-October of 1958 and March of 1959 on a scale of 1:24,000. The author is grateful to Drs. R. H. Merriam, R. O. Stone, and T. Clements of the Geology Department, University of Southern California, for their helpful guidance during the project.

ROCK UNITS

Precambrian Rocks

Precambrian rocks in southeastern California can be divided into an older group which consists predominantly of gneisses, mica schists, quartzites and marbles, and a younger series of metasedimentary rocks that unconformably overlie the older crystalline gneisses. Only the older group of rocks are exposed in the area mapped, and they consist of gneisses and interlayered gneisses, schists, and quartzites.

Three separate exposures of Precambrian rocks, each greater than 3 square miles in area, have been mapped in the northern part of the quadrangle. Gneiss and hornblende gneiss, exposed west of Old Dad fault, are unconformably overlain by beds of the Prospect Mountain Quartzite and are in thrust fault contact with Goodsprings Dolomite. Here rock foliation trends generally northwest and dips steeply northeast. Gneiss, mica schist and quartzite, together with many small dikes of various composition, comprise the low hills south of Seventeenmile Point. Indistinct bedding of the quartzite and foliation of the schist in these low hills suggest a northerly trend with a gentle east dip. The hills west of the Quaternary basalt flows are made up of gneiss which has been intruded by the Teutonia Quartz Monzonite.

Typically, the gneiss consists of alternating white granulose and dark green to black schistose bands. The lighter colored layers contain equigranular plagioclase feldspar and quartz, whereas the generally thicker dark layers are hornblende and biotite. Thickness of the bands ranges from a fraction of an inch to several feet. These rocks are referred to as either granite-gneiss or granitic gneiss wherever the banding is obscure.

Quartzites are brown to red-brown, fine grained, and locally show traces of lamination. They are usually interlayered, on a large scale, with biotite hornblende schists.

A medium to course-grained granite, containing large crystals of pink orthoclase with quartz, plagioclase, and biotite, comprises a minor part of the Precambrian complex in this area. Clasts of this granite are abundant in parts of the older alluvial gravels.

Quartz veins, lenticular zones of epidote, and a great variety of dikes, including alaskite, syenite, dacite porphyry, diorite porphyry, and quartz diorite porphyry randomly cut the gneiss, schist, and quartzite at several localities. Although some of these dikes may be of Precambrian age, others are possibly Mesozoic or even Tertiary in age.

Paleozoic Rocks

Prospect Mountain Quartzite. This formation was first mapped in the Eureka district of Nevada by Hague (1892, p. 419), where it consisted of 1,500 feet of bedded quartzite with occasional thin layers of shale. Only a few square miles of this unit are exposed in the Old Dad Mountain area.

A stratigraphic section, measured on a single fault-block east of the Old Dad fault, was 2,142 feet thick. This is a minimum thickness because the section lacks the equivalent beds that are present elsewhere in the area mapped. West of Old Dad fault, interbedded dolomite and quartzite beds, which strike N. 40°–50° W., dip 35°–50° NE, and rest unconformably on Precambrian gneiss, have been extensively altered by Mesozoic(?) or Tertiary(?) intrusive rock. The faulted and intruded nature of these sedimentary rocks, together with the lack of good marker beds, makes stratigraphic correlation difficult.

The lower 400 feet of the stratigraphic section is mainly massive dolomite, light to medium gray and light brown on both the fresh and weathered surfaces. Bedded dolomite occurs in the upper half of the stratigraphic section and offers much greater color variation, including dark brown and gray, black, rust brown, and pinkish-gray.

Red-brown, brown, gray, and white well-bedded quartzite is located throughout the section. The individual beds range in thickness from a few inches to about 20 feet. Locally, the quartzite is cross-bedded.

Black slate occurs in the middle part of the eastern section, and weathers black, grayish black, and greenish black. Most of the slate is extremely fissile, with parting thicknesses ranging from a few millimeters to a few inches. Cross-bedding is evident where closely spaced laminae, made up of darker mineral grains, are present.

Minor amounts of white massive sandstone and brown thin bedded shale occur in the dolomite and quartzite east of the Old Dad fault.

Hewett (1956) thought the Prospect Mountain Quartzite in the Ivanpah quadrangle might be equivalent to the Johnnie, Stirling and Wood Canyon Formations at Spring Mountain, Nevada. In regard to the Old Dad Mountain exposure, Hewett (1956) stated:

> compared with the section recorded by Nolan (1929) near Johnnie, it resembles the Wood Canyon formation more than the underlying Stirling quartzite and Johnnie formation.

After observing some of these outcrops in the Old Dad Mountain area, L. A. Wright (California Division of Mines, oral communication, 1959) felt that the Johnnie Formation, Stirling Quartzite, and possibly the uppermost part of the underlying Noonday Dolomite were represented here. This writer, on the basis of a generalized lithologic correlation with the section recorded by Hazzard (1937) in the Nopah Range, about 60 miles north of Old Dad Mountain, thinks that the formation is equivalent to parts of the Noonday Dolomite, Johnnie Formation, Stirling Quartzite and the Wood Canyon Formation, but because of a lack of certainty, these units were not differentiated on the geologic map. These formations are considered by most investigators to be of questionable Early Cambrian age.

The Prospect Mountain Quartzite in the Old Dad Mountain area is intermediate in thickness between the 1,085 feet of similar beds described by Hazzard (1954) in the Providence Mountains to the southeast and 2,750 feet reported by Grose (1959) in the Soda Mountains to the northwest.

Goodsprings Dolomite. Hewett (1931, p. 11) named the unit for its occurrence near the town of Goodsprings, Nevada. A section measured by Hewett at Sheep Mountain, east of Jean, Nevada, is about 2,500 feet thick; in the Old Dad Mountain area it appears to be 2,870 feet thick.

Within the area mapped, the Goodsprings Dolomite crops out above the eastward-dipping Playground thrust fault, at the eastern end of Little Cowhole Mountain and at Cowhole Mountain. In these areas, the formation trends generally northwestward and dips 45°–75° to the northeast. A section, measured at Little Cowhole Mountain, showed 1,080 feet of well-bedded dolomite. As much as 1,790 feet of massive multi-colored marble probably overlies the bedded dolomite. If the sand-concealed contact between the dolomite and marble is stratigraphic, and the massive marble has an attitude similar to the dolomite, the thickness of the formation here would be 2,870 feet. It is possible, however, that the boundary between the two units is a fault contact.

The bedded dolomite is blue, blue-gray, light to dark brown, and white. Alternating brown and blue-gray laminae are a characteristic feature of the unit, but most of the dolomite beds range from 1 foot to 10 feet in thickness. The dolomite is medium to coarsely crystalline, locally fractured at right angles to the bedding, and contains many randomly oriented small white calcite veinlets. Locally, elongated chert nodules as much as 8 inches long and 4 inches wide are present. Parts of the dolomite above the Playground thrust plate contain persistent black chert bands 2 to 4 inches thick and separated by an equal thickness of dolomite.

No fossils were found in the Old Dad Mountain area, and the Late Cambrian to Devonian age was assigned to the formation by Hewett (1931) on the basis of fossils collected in the Goodsprings district.

Sultan Limestone. The Sultan Limestone was named and divided into the Ironside Dolomite, Valentine Limestone, and Crystal Pass Limestone members at the type locality near the Sultan mine in the Goodsprings district Nevada by Hewett (1931, p. 13).

In the area mapped, 208 feet of the formation are exposed on the west and south slopes of hill 2252 at northern Cowhole Mountain. Here the formation, which trends northwest and dips 40°–50° northeast, is intruded by Jurassic(?) and Late Tertiary(?) igneous rocks to the north, west and south, and is in normal fault contact with the Monte Cristo Limestone and Bird Spring Formation to the east. The Ironside, Valentine and Crystal Pass Members are thought to be present in this intruded, fractured and bleached mass of carbonate rock, but because they cannot be certainly identified, the unit is, herein, given its collective title, Sultan Limestone.

Section measured on the west slope of hill 2252 at northern Cowhole Mountain.

	feet
Normal fault.	
Sultan Limestone.	
Crystal Pass(?) Member:	
Limestone, dolomitic limestone and dolomite; white to brown, mottled and locally bleached; sandy to the touch, well pitted; finely crystalline, massive, highly fractured and poorly resistant; outcrops scarce	67
Valentine(?) Member:	
Mostly limestone; gray to light brown; extensively pitted; coarsely crystalline and massive except for a few discontinuous dolomite bands less than 1 inch thick; cliff-former	100
Limestone; alternating bands (1 inch to 4 inches) of dark blue-gray and light gray-brown, locally bleached; surface pitted, grooved parallel to bedding plane trace; coarsely crystalline; cliff-former	10
Ironside(?) Member:	
Dolomite and dolomitic limestone; dark blue-gray to black, locally bleached to light grays and browns, and locally mottled; weathered surface is sandy to the touch, pitted, grooved and locally coated with white calcite; medium to finely crystalline and occasionally laminated (alternating dark blue-gray and gray bands less than 1 inch thick); chert layers less than 1 inch thick separated by ½ inch to 2 inches of mottled dolomite near middle of member; numerous fractures at right angles to bedding	31
Total	208

Because this exposure of the Sultan Limestone is unfossiliferous, a Middle Devonian age, which was determined by Edwin Kirk from fossils at exposures elsewhere in the Ivanpah quadrangle, has been assigned (Hewett, 1956).

Monte Cristo Limestone. The name Monte Cristo Limestone was applied to marine beds that overlie the Sultan Limestone and underlie the Bird Spring Formation north of the Monte Cristo mine in Goodsprings quadrangle, Nevada by Hewett (1931, p. 17). Hewett also named the Dawn Limestone, Anchor Limestone, Bullion Dolomite, Arrowhead Limestone, and Yellowpine Limestone Members of this formation.

In the Old Dad Mountain area only the Anchor Limestone and the conformably overlying Bullion Dolomite members are present. They are exposed high on the western slope of hill 2252 at Cowhole Mountain. These members, which are in normal fault contact with the underlying Sultan Limestone and are conformably overlain by the Bird Spring Formation, strike northwest and dip 50°–60° to the northeast. They have a combined thickness of 78 feet.

The chert-bearing Anchor Limestone Member is dark gray to black, weathers dark to blue-gray, and in most places shows pale orange-brown surface stains around the black chert bands and nodules. White cross-cutting calcite veinlets as much as a quarter of an inch thick are common. Highly fractured black chert occurs in discontinuous stringers 1 inch to 8 inches thick separated by a slightly greater thickness of porcelain-like limestone, and also as elongated nodules as much as 8 inches long and 4 inches wide.

The Bullion Dolomite is coarsely crystalline, light to medium gray, occasionally mottled, and locally bleached to lighter shades, including white. Elongated chert nodules, as much as 12 inches long and 8 inches wide occur locally. The member is massive and cliff forming. Where the Anchor Limestone is thick the Bullion Dolomite is thin or missing and, conversely, where the Bullion Dolomite is thick the Anchor Limestone is thin or absent.

No identifiable organic remains were found in the Anchor Limestone, but abundant crinoid stems and plates were recognized in the Bullion Dolomite. Girty identified brachiopods, collected from the Anchor and Arrowhead Members in the Goodsprings quadrangle, as Early Mississippian (Hewett, 1956).

Bird Spring Formation. This unit was named for 2,500 feet of Late Paleozoic limestone, dolomite, shale and sandstone that crops out on the western slope of the Bird Spring Range near Goodsprings, Nevada by Hewett (1931, p. 21). In the Las Vegas quadrangle the formation has been divided by lithology and fusulinid distribution into five members ranging from Upper Mississippian to middle Lower Permian (Longwell and Dunbar, 1936).

In the area mapped, the formation crops out on hill 2252 at northern Cowhole Mountain, with a measured thickness of 2,950 feet. The unit strikes slightly west of north and dips 35°–55° east, and is intruded by the Jurassic(?) Sands Granite. It is faulted against the Goodsprings Dolomite to the northeast and the Sultan Limestone to the south and southwest, and conformably overlies the Monte Cristo Limestone on the west. No evidence of an unconformity, local or regional, between the Monte Cristo Limestone and the overlying Bird Spring Formation was observed.

Typical limestone and dolomite of the formation weather light-to dark-gray, bluish gray, light to medium-brown, orange-brown, white, and red. Most of the gray to blue-gray beds are from 1 foot to 20 feet thick and composed of medium to finely crystalline rock. The typical orange-brown weathering bed, 6 inches to 10 feet thick and very finely crystalline, is dark blue-gray on a freshly broken surface. Elongated black chert nodules, as long as 2½ feet and as much as 10 inches thick occur in the typical limestone and dolomite beds.

An interbedded dark gray limestone and black chert unit forms the lowermost 12 feet of the formation. Chert layers are half an inch to 2 inches thick and are separated by 1 inch to 6 inches of limestone mottled with white spots in a dark gray field. The chert content of the bed is estimated to be 30 or 40 percent.

A second chert-bearing limestone unit, 150 feet thick and consisting of chert layers 1 inch to 3 inches thick separated by 2 to 6 inches of finely crystalline, light gray limestone, is just below the middle of the formation. Both chert-bearing units resemble the Anchor Limestone Member of the underlying Monte Cristo Limestone.

Thin beds of platy limestone near the middle of the formation weather pink to pinkish gray and are seldom thicker than 5 feet. These finely crystalline platy units are separated by 3 to 15 feet of massive limestone and dolomite beds.

Fossils Collected From the Cowhole Mountain Outcrop

Fusulinids:
- *Schwagerina*, sp.
- *Pseudoschwagerina*, sp.
- *Triticites* (?), sp.

Corals:
- *Amplexocarina* (?), sp.
- *Syringopora*, sp.
- *Chaetetes*, sp.

Echinoderms:
- Crinoid fragments

Others:
- Unidentifiable brachiopod and bryozoan fragments

Generalized distribution of the fusulinid genera in the Bird Spring Formation at Cowhole Mountain is approximately as follows:

1500 to 2550 feet=*Schwagerina* zone
600 to 1500 feet=*Pseudoschwagerina* zone (includes *Schwagerina*)
450 to 600 feet=*Schwagerina* zone
250 to 450 feet=*Triticites* (?) zone
Base of Formation to 250 feet=fusulinids lacking

The Bird Spring Formation exposed in the area mapped is believed to be equivalent to "members number 4 and 5" and possibly the upper part of "member number 3" of Longwell and Dunbar (1936). This includes the Virgilian(?), Wolfcampian and Leonardian stages of the Upper Pennsylvanian and Lower Permian systems.

Mesozoic Rocks

Aztec Sandstone. Hewett (1931, p. 35) applied the name Aztec Sandstone to 2,100 feet of wind-deposited sandstone that overlies Triassic rocks in the Spring Mountains of Nevada.

In east-central and southern Cowhole Mountain the formation strikes roughly north, and dips as much as 85° E. The Aztec Sandstone is faulted against the Goodsprings Dolomite to the west and nonconformably overlain by lava flows on the east.

Unlike the type locality, the unit at Cowhole Mountain contains a boulder breccia lens, approximately 15 feet thick and 250 feet long, near the base of the faulted section.

At east-central Cowhole Mountain, the formation measures 1,975 feet consisting predominantly of well-indurated sandstone. Farther south, the formation consists of approximately 2,100 feet of dense quartzite. The sandstone is medium to coarse grained, fairly well sorted, and consists of subangular to subrounded, generally frosted quartz grains that are well-cemented by siliceous, and, less frequently, calcareous materials. Brick and wine red, light purple, red-brown, and various shades of pink, peach, buff and white are common among the many colors that have been observed on the fresh and weathered surfaces of the sandstones.

The quartzite is buff, brown, and light-red on fresh surfaces, but weathers dark brown to black (desert varnish). Often the weathered surface is similar to, and locally indistinguishable from, that of the andesite dikes which intrude the formation. Dense, finely crystalline quartzite units are more or less uniformly indurated throughout the 2,100 feet of section.

The boulder breccia consists of a buff to red sandy matrix that weathers brown to black (desert varnish) and large light blue-gray carbonate clasts. Fine quartz sand grains of the matrix are subangular in shape, well sorted, and fairly well-cemented with calcareous cement. The angular to subrounded clasts, as much as 14 inches in diameter, are predominantly limestone with some dolomite and chert. These clasts, many of which contain solitary corals 1 inch to 2 inches long, fusulinids and crinoid plates, were derived from the Bird Spring Formation.

On the basis of stratigraphic poistion Hewett (1931) assigned the Aztec Sandstone to the Jurassic System. Small animal tracks, considered to be those of a Jurassic dinosaur, have been reported in the Mescal Range by J. R. Evans (oral communication 1958).

Sands Granite. The Sands Granite was named for its occurrence near Sands, a small community along the Southern Pacific Raliroad in the southwestern corner of Old Dad Mountain quadrangle (Hewett, 1956, p. 44).

Geologic history of the northern portion of Old Dad Mountain quadrangle

System or Epoch	Sedimentation	Igneous Activity	Deformation	Erosion
Recent	Younger alluvium and sand dunes	Basalt flows and cinder cones		Local, internal
Pleistocene	Older alluvium	Mineralization	Normal faults	
Late Pliocene (?)	Breccia		Old Dad Fault (?) Playground	Widespread, external
Middle Pliocene (?)		Dikes and sills	Thrust (?)	
Miocene Oligocene Eocene Paleocene				Widespread, profound, external
Upper Cretaceous to Lower Tertiary (Laramide)		Mineralization Dikes and sills Teutonia Quartz Monzonite	Folding of sediments	Local, internal
Upper Jurassic (?)		Lava flows		
Jurassic (?)	Aztec Sandstone	Sands Granite		
Permian	Bird Spring Formation			
Pennsylvanian Mississippian	Monte Cristo Limestone			
Devonian	Sultan Limestone			
Lower Devonian Silurian	Goodsprings Dolomite			
Ordovician Upper Cambrian Lower Cambrian	Prospect Mountain Quartzite			
Precambrian	Sedimentary counterparts of gneiss, schist and quartzite	Metamorphism Major and minor intrusives	Widespread folding and faulting	Widespread, profound, external

Approximately 1 square mile of this unit forms the low hills along the western side of Cowhole Mountain, where it intrudes the Goodsprings Dolomite and the Sultan Limestone, and has been cut by numerous northwest-trending andesite dikes. Although the unit as mapped in the Old Dad Mountain area is mineralogically a quartz monzonite, the term Sands Granite is retained. Hewett (1956, p. 44) tentatively associated this rock with the Nevadan orogeny, and thus dated it as Jurassic(?).

The Sands Granite is typically medium to locally fine-grained, and composed of albite (45 percent), orthoclase (40 percent), quartz (12 percent) and biotite (3 percent) arranged in a hypautomorphic-granular manner.

Lava Flows. The lava flows, which occur on the northeast side of Cowhole Mountain, are 2,060 feet thick and trend generally north and dip moderately to the east. They unconformably overlie the older Aztec Sandstone to the west, are cut off by faults to the north and are concealed by recent alluvium to the east. Four rock types have been recognized. They are, from oldest to youngest: medium purple quartz latite, dark purple basalt, medium gray dacite, and dark red quartz latite. Dacite flow breccias and flows which overlie the Aztec Sandstone in other parts of the Ivanpah quadrangle are of questionable Late Jurassic age (Hewett, 1956); in the absence of conflicting evidence, the same age is accepted for these rocks.

The basal quartz latite is light- to medium-purple, massive, closely fractured in places, and weathers into large blocky fragments. This rock, which is porphyritic with a very fine holocrystalline to aphanitic groundmass, contains abundant phenocrysts of plagioclase, orthoclase, and quartz in nearly equal proportions.

The dark purple basalt weathers brown to black, is massive, locally closely fractured, and is the most resistant to weathering of the four flows. A few phenocrysts of plagioclase occur in a very fine holocrystalline to aphanitic groundmass.

The medium gray dacite, which occurs to the east of the main dark purple basalt exposure, is massive and weathers brown to gray. Both plagioclase and quartz phenocrysts are in a very fine holocrystalline to aphanitic groundmass.

The uppermost unit, quartz latite, is dark red-brown, weathers black to red-brown, is very well fractured, and the least resistant rock type in the series. Nearly equal amounts of potash, feldspar, plagioclase, and quartz are present.

Teutonia Quartz Monzonite. Teutonia Quartz Monzonite is the name proposed by Hewett (1956) for several large bodies of intrusive rock that are exposed in a broad belt extending across the southern half of the Ivanpah quadrangle. The name was derived from Teutonia Peak, a prominent topographic feature on the northeastern slope of Cima Dome. Characteristically, the rock is quartz monzonite, but one mappable variety is biotite-rich quartz diorite.

The typical quartz monzonite is a light gray, medium- to coarse-grained, holocrystalline rock with a hypautomorphic granular texture. Estimated percentages of its constituent minerals are:

Mineral	Percent
orthoclase	40
quartz	30
plagioclase	25
augite	3
biotite	1
apatite	Tr.
magnetite	Tr.
saussurite	Tr.

The quartz diorite variety is a light gray to light blue-gray, holocrystalline rock composed of fine-grained crystals of quartz (50 percent), plagioclase (40 percent) and biotite (10 percent) intergrown in a hypautomorphic granular fashion.

Tertiary Rocks

Dikes. A northwest trending swarm of andesite dikes cut the Goodsprings Dolomite, Aztec Sandstone, Sands Granite and the lava flows in the central part of Cowhole Mountain. Most of the dikes are highly resistant to erosion and form prominent ridges. They are light brown, gray, and pale green in color. Dike rock is mostly massive and very fine-grained, but locally it contains medium-grained phenocrysts of plagioclase. A diabasic dike occurs in the central part of Cowhole Mountain. It is dark green to black in color and shows medium-grained plagioclase crystals enclosed by clusters of fine-grained augite. These dikes are, apparently, of Tertiary age.

Breccia. Carbonate rock breccia is exposed 4 miles northeast of Cowhole Mountain in a northwest-trending ridge approximately 1 mile long, 1,000 to 2,000 feet wide, and as much as 360 feet higher than the surrounding alluvium. It is faulted against Precambrian gneiss to the east and is covered by alluvium to the north, south and west.

The breccia is light gray and contains angular to subrounded cobbles, apparently derived from the Goodsprings Dolomite, embedded in a poorly sorted, well cemented, sandy-calcareous matrix. Local black chert nodules, some of which are about 8 inches long and 4 inches wide, are also present but show no alignment. A few highly fractured chert masses attain diameters in excess of 1½ feet. The unit is at least 400 feet thick. A small, light-colored and highly fractured, very fine-grained to aphanitic dike intrudes a portion of the breccia.

A sandy-calcareous matrix, angularity of clasts, and locally developed crude bedding suggest a sedimentary origin for the breccia.

The fact that it is cut by a Pliocene(?) fault, intruded by a Tertiary(?) dike, and is deeply weathered, suggests a Late Tertiary age for the breccia.

Quaternary Rocks

Basalt flows and cinder cones. Approximately 15 square miles of basalt flows, as much as 50 feet thick, which are capped by cinder cones, occurs in the northeastern corner of the area mapped. The flows form the southwestern tip of a lava field which covers more than 75 square miles. Within the mapped area most of the flows apparently rest upon an old erosion surface developed on the Teutonia Quartz Monzonite. Locally, the flows overlie Precambrian gneiss or as much as 50 to 100 feet of stratified, semi-consolidated sand.

The youngest of these flows has breached the southwestermost cinder cone in the area and flowed 8,000 feet to the west. This is the only flow younger than the cinder cones.

The basalt flows are surmounted by eight major cinder cones (highest is about 600 feet) and one smaller satellite cone, each of which marks the location of a lava vent. Most of the cones have a simple symmetrical profile with a crater at the summit.

Most of the basalt in the area contains a few white plagioclase phenocrysts embedded in a black aphanitic groundmass. Although only a single crystal of olivine was noted in the flow basalt, a few small peridotite and dunite bombs were collected from the rim of the small, triple-cratered cinder cone in section 14, T. 13 N., R. 11 E.

Hewett (1956) reported that basalt from the cone a short distance east of section 19, T. 13 N., R. 12 E., contains irregular phenocrysts of clear andesine (An_{30}) as much as 1½ inches in diameter set in a groundmass of fine labradorite (An_{65}) blades.

Older flows in this area are weathered, eroded, partially covered by vegetation, locally covered by Recent alluvium and do not conform to present topography; they are considered to be of Pleistocene age.

The cinder cones and the youngest basalt flow are believed to have been extruded in very recent geologic time, possibly within the past few thousand years, from the following evidence:

1. Lack of erosion of cones and flow; fragmental or clinker phase makes up large percentage of flow.
2. Almost complete conformity of flow to present topography (maximum post-volcanic downcutting of adjacent recent alluvium is less than 10 feet in a constricted portion of stream channel).
3. General lack of vegetation and soil on cones and flow.
4. Fresh appearance of lava surface.
5. General correlation (appearance and composition) with Recent flows near Amboy and Pisgah, about 40 miles to the south.

Unconsolidated deposits. The high, well-rounded hills in the south-central part of the mapped area are composed of older alluvial sand and conglomerate. Some boulders in the conglomerate are as much as 6 feet in diameter, but most of the fragments are of cobble and smaller boulder size. Crudely stratified, semi-consolidated conglomerate is exposed in recent stream cuts in the northwest part of the hills. Other unconsolidated deposits consist of Recent alluvium, sand dunes (as much as 40 feet high), and small playa lake beds near hill 2252 at Cowhole Mountain.

STRUCTURAL FEATURES

The most persistent structural feature is the Old Dad fault of Hewett (1956, p. 100) which is prominently exposed on the east slope of Old Dad Mountain (9 miles SE of Little Cowhole Mountain) and its northern extension for a distance of 5 miles. Within the mapped area, the fault trends N. 30°–40° W. and dips 70° NE, and can be traced for 2 miles. Old Dad fault is a reverse or high-angle thrust fault with the footwall block (west) consisting of Goodsprings Dolomite, Prospect Mountain Quartzite and Precambrian gneiss. The hanging wall block (east), which has apparently moved relatively upward, is composed of Precambrian gneiss covered by older alluvial gravel. Erosion of the less resistant Precambrian rocks northeast of the fault has produced, in most places, an obsequent faultline scarp. Older alluvial gravels have been deposited against and even across this scarp. The relationship of the two blocks is well shown 1 mile south of the mapped area, where the Old Dad fault cuts the Playground thrust fault. Field evidence indicating age and magnitude of the displacement on the Old Dad fault is lacking.

The Playground thrust fault, originally mapped by Hewett (1956, p. 100), forms a sinuous contact between the overlying Goodsprings Dolomite and the underlying Precambrian gneiss and Prospect Mountain Quartzite in the south-central part of the area. This relatively flat thrust fault trends generally N. 25°–35° W. and dips 15° to 20° NE. From a distance, the fault can usually be recognized by the distinct break in slope between the highly resistant Goodsprings Dolomite and the less resistant rock units beneath it. Although much of the contact is concealed by rock slides from the upper plate, exposures in stream cuts usually reveal 5 to 10 feet of breccia composed of carbonate rock fragments. Workings of the Sweet and Lucky gold mines penetrate mineralized areas of the fault plane.

Precise age and displacement of this post-Paleozoic pre-Quaternary thrust fault are not known. Because of the lack of a definite age determination of the Mesozoic and Tertiary rocks it is difficult to know whether thrusting took place during the Laramide Orogeny or the Cascadian Orogeny. At present, it seems best to accept the post-early Pliocene(?) age assigned to the Playground thrust fault by Hewett (1956, p. 100-101). The structural features of the Playground thrust fault area much resemble those features found in the Kingston thrust fault area in the Shadow Mountains, 30 miles to the north. Hewett, therefore, correlated the two thrust faults and assigned a post-early Pliocene(?) age to both.

A normal fault, which trends N. 75°–85° E. and dips approximately 40 degrees south, forms the contact between the Precambrian basement rocks and the Prospect Mountain Quartzite a few miles south of Seventeenmile Point. This fault is offset by a series of three semi-parallel normal faults which strike N. 60° W. and dip 70° to 80° NE. West of the Playground thrust fault, a normal fault that trends northwest and dips southwest separates the Precambrian gneiss from the sedimentary breccia composed of Goodsprings Dolomite. Radical, but consistent, changes in attitude of the Precambrian gneiss foliation suggest a concealed extension of the fault under the alluvium northwest and southeast of its mapped trace.

Nearly vertical normal faults at Cowhole Mountain can be grouped into an older north-south trending group, and a younger, roughly east-west trending group. Evidence for most of the first group is absence of rock units, whereas evidence for most of the second group is lateral displacement of beds. A late Tertiary age is assigned to the three major east-west trending normal faults because they displace intrusive rocks of Tertiary(?) age.

Beds in the Paleozoic and Mesozoic formations exposed within the area mapped have been tilted into a homocline. One minor anticline is present in the Goodsprings Dolomite exposed on Little Cowhole Mountain, and a broad anticlinal warp is in the Precambrian gneiss southwest of Indian Spring.

ECONOMIC GEOLOGY

The most important metallic mineral commodities in the northern portion of Old Dad Mountain quadrangle have been gold, silver, and lead. Known production has been limited mainly to gold and silver with

Gold and silver mines and prospects in the northern portion of Old Dad Mountain quadrangle

Name	Location	Country rock	Elements	Approximate total ore value, in dollars*	Occurrence	Owners
Paymaster (Whitney) Mine	Sec. 23, T13N, R10E	Precambrian gneissic complex	Gold and silver	150,000–200,000	Series of quartz veins in complex of igneous and metamorphic rocks	Lawrence Bess, 890 Campus Way, San Bernardino, Calif. Walter Thompson & associates, 1010 Cadberry Rd., Whittier, Calif.
Oro Fino Mine	Sec. 23, T13N, R10E	Precambrian gneissic complex	Gold and silver	95,000	Discontinuous faulted and folded shoots 4 to 6½ feet wide and lenticular in shape	Jerry Korfist and associates, Baker, Calif.
Gold Cycle (Arrow Trust) Mine	Sec. 23, T13N, R10E	Precambrian gneissic complex	Gold and silver	95,000	similar	Same
Brannigan Mines						
a) Numbers 1 & 2	Sec. 26, T13N, R10E	Prospect Mountain Quartzite and Precambrian gneissic complex	Gold and silver	10,000–15,000	Discontinuous quartz veins 3 to 6 feet thick in fracture zones in quartzite	Walter Thompson and associates, 1010 Cadberry Rd, Whittier, Calif.
b) East	Sec. 26, T13N, R10E	Prospect Mountain Quartzite	Gold, silver, lead	1,200	similar	Walter Thompson and associates, 1010 Cadbury Rd, Whittier, Calif.
c) North	Sec. 26, T13N, R10E	Precambrian gneissic complex	Gold, silver, copper	?	similar	Walter Thompson and associates, 1010 Cadbury Rd, Whittier, Calif.
Comet Mine	Sec. 26, T13N, R10E	Prospect Mountain Quartzite	Lead, gold, silver	?	Fracture zones in quartzite and dolomite. May be some replacement	Walter Thompson and associates, 1010 Cadbury Rd, Whittier, Calif.
Lucky Mine	Sec. 11, T12N, R10E	Precambrian gneissic complex	Gold and silver	17,600	Playground thrust zone between goodsprings Dolomite and Precambrian gneiss	J. E. Stevenson, Los Angeles, Calif.
Rainy Day Prospect	Sec. 21, T13N, R11E	Prospect Mountain Quartzite	Lead, silver, gold and molybdenum	none	In fractured quartzite and/or replaced dolomite	Jerry Korfist, Baker, Calif.
Big Horn Prospect	South of Sec. 26, T13N, R10E	Older alluvial breccia	Lead, silver, gold and molybdenum	none	Small fractures in older alluvial carbonate breccia	Jerry Korfist, Baker, Calif.
Sweet Prospect	North of Sec. 10, T12N, R10E	Prospect Mountain Quartzite and Goodsprings Dolomite	Gold and silver	none	In Playground thrust zone between Goodsprings Dolomite and Prospect Mountain Quartzite	unknown

* Oral communication, Jerry Korfist.

minor amounts of lead and copper. Several vein deposits are localized in Pliocene(?) fault zones, and one other deposit (Big Horn prospect) occurs in Pleistocene(?) breccia.

At least one thin but persistent hematite-magnetite bed occurs as a replacement of dolomite in the western exposure of the Prospect Mountain Quartzite. This bed, like the rest of the formation, strikes northwesterly, and dips moderately to the northeast. Exploration work was performed prior to 1953 by the Minerals Materials Company, Alhambra, but no production has resulted.

Several thorium-uranium claims were staked in the Precambrian basement rocks in the general vicinity of section 24, T. 13 N., R. 10 E. No information was obtained pertaining to the minerals present or the type of mineral occurrence; no production resulted.

Cinder deposits held by the Cima Cinder Co., Los Angeles, in the northeast part of the quadrangle, are mined principally for use in lightweight aggregate. Access roads are maintained to at least four of the nine cinder cones.

Several pits on the Brannigan gold mining property have yielded a few tons of variegated lavender, orange, and red shales which have been sold as ornamental stone. Locally called "wonder stone", these shales occur in the upper part of the Prospect Mountain Quartzite. Examples of the finished product may be seen on the interior walls of the Baker Inn, in Baker.

A large marble deposit, almost completely covered by windblown sand, occurs at the eastern tip of Little Cowhole Mountain. This deposit and those like it in central Cowhole Mountain, are in the Goodsprings Dolomite. The marble is massive and occurs in various shades of blue, gray, brown, black, green, red, and white. It is finely crystalline, contains numerous calcite veinlets, and locally includes small brecciated masses in which angular marble clasts are embedded in a white calcite matrix. Claim owner Max C. King of Los Angeles and his associates stated their intention to market the marble as terrazzo and other small products to the writer in 1959. Marble at Little Cowhole Mountain appears to be of sufficient size and quality to be exploited, possibly as dimension stone.

The altered zone, next to the large diabasic dike that intruded the Goodsprings Dolomite in central Cowhole Mountain, contains abundant small crystals of garnet which may have some use as an abrasive.

In the northern part of section 9, T. 13 N., R. 11 E., groundwater, flowing in the alluvial fill of a stream cut, rises to the surface over a small outcrop of Precambrian gneiss to form Indian Spring. In December, 1958, the rate of flow at the spring was about 1.5 to 2.0 gallons per minute. By March 1959, the rate had diminished to about 1 gallon per minute. The spring was initially developed in 1910 when the water was piped 5 miles southwest to the Paymaster mine millsite (Hewett, 1956).

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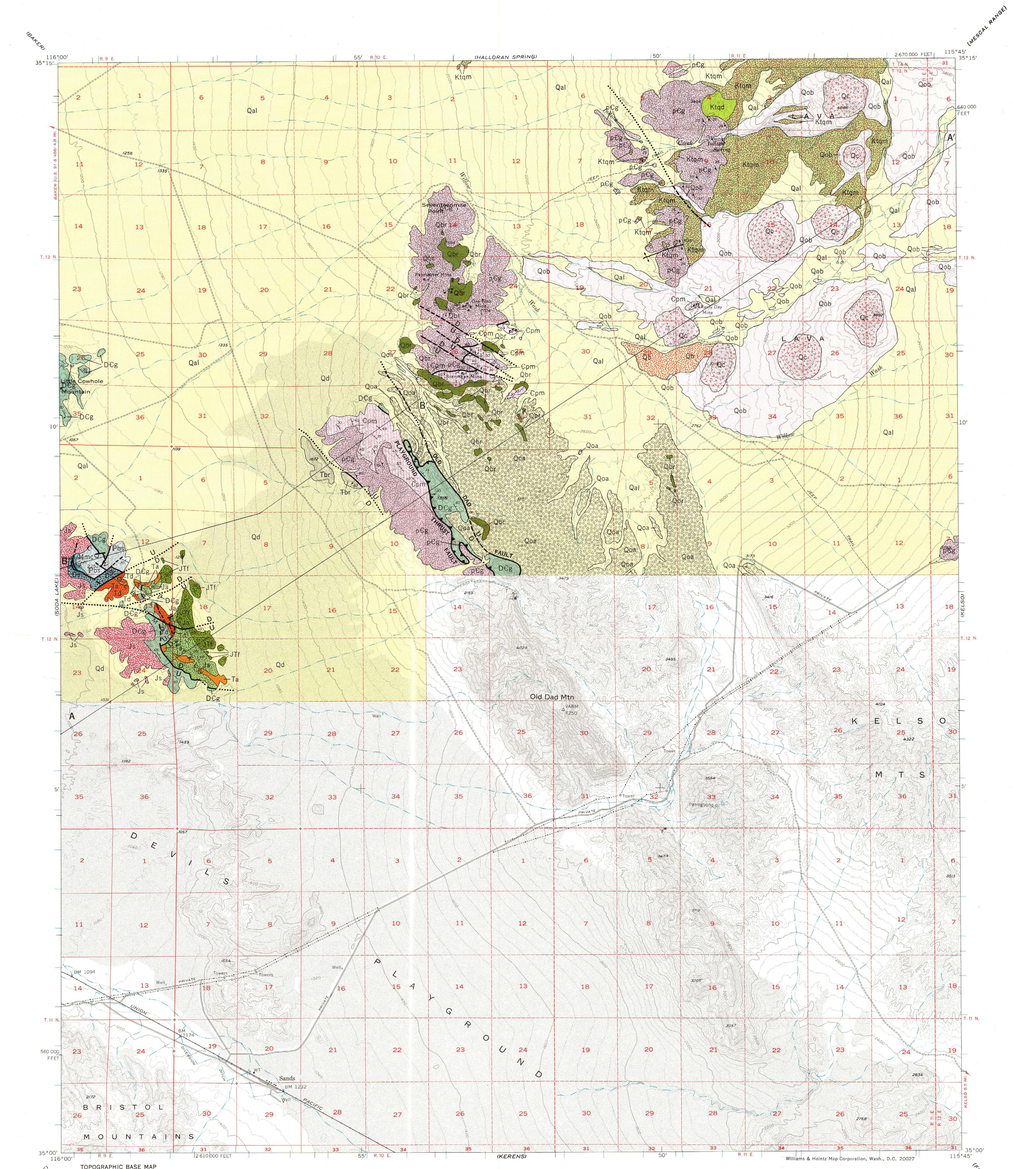
GEOLOGIC MAP AND SECTIONS OF THE NORTHERN PORTION OF OLD DAD MOUNTAIN QUADRANGLE, SAN BERNARDINO COUNTY, CALIFORNIA

Geology by Richard A. Barca, 1960.

MAP SHEET 7
DIVISION OF MINES AND GEOLOGY
Ferry Building, San Francisco
Ian Campbell, Chief
1965
State of California
The Resources Agency
Department of Conservation



TOPOGRAPHIC BASE MAP
Mapped, edited, and published by the Geological Survey
Control by USGS and USC&GS
Topography from aerial photographs by multiplex methods
and by planetable surveys 1956. Aerial photographs taken 1953.
Polyconic projection. 1927 North American datum
10,000-foot grid based on California coordinate system, zone 5

SCALE 1:62500

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

QUADRANGLE LOCATION

APPROXIMATE MEAN DECLINATION, 1956

EXPLANATION

QUATERNARY — Recent (?)

- Qd / Qal — Alluvium; Qd – sand dunes
- Qb — Basalt flow
- Qc — Cinder cone

QUATERNARY — Pleistocene (?)

- Qob — Older basalt flow
- Qbr — Limestone - dolomite breccia
- Qoa — Older alluvium

TERTIARY — Pliocene (?)

- Tbr — Sedimentary breccia of Goodsprings Dolomite

TERTIARY (?)

- Ta — Andesite
- Td — Diabase

CRETACEOUS

- Ktqm — Teutonia Quartz Monzonite and quartz diorite

JURASSIC TO TERTIARY

- JTf — Flows of quartz latite, basalt, and dacite

JURASSIC (?)

- Js — Sands Granite
- Ja — Aztec Sandstone

PENNSYLVANIAN TO PERMIAN

- Pbs — Bird Spring Formation

MISSISSIPPIAN

- Mmc — Monte Cristo Limestone

DEVONIAN

- Ds — Sultan Limestone

CAMBRIAN TO DEVONIAN

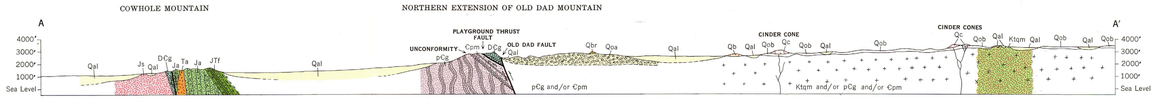
- DCg — Goodsprings Dolomite

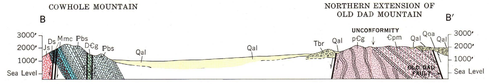
CAMBRIAN

- Cpm — Prospect Mountain Quartzite

PRECAMBRIAN

- pCg — Gneiss, schist, and quartzite





ERA	SYSTEM	SERIES	FORMATION	MEMBER	SYMBOL	THICKNESS	ROCK DESCRIPTION
CENOZOIC	QUATERNARY	RECENT	ALLUVIUM		Qd Qal	0-1500'	Unconsolidated silt to boulder-sized material of all preceding rock units. Sand dunes. Small playa deposit in Sec. 32, T.12N., R.9E.
		RECENT (?)	BASALT	FLOW	Qb	0-40'	Basaltic lava flows locally capped by cinder cones. Youngest flow breaches cinder cone.
				CINDER CONES	Qc		
		PLEISTOCENE (?)	OLDER ALLUVIUM	FLOW	Qob	0-200'	Limestone-dolomite breccia
				BRECCIA	Qbr		
				GRAVEL	Qoa Qoo	0-800+'	Unconsolidated silt to boulder-sized material of all old rock units.
	TERTIARY (?)	PLIOCENE (?)		SEDIMENTARY BRECCIA	Tbr	450'	Clasts derived almost exclusively from Goodsprings Dolomite.
MESOZOIC	UPPER JURASSIC (?) TO TERTIARY		LAVA FLOWS OF COWHOLE MOUNTAIN	QUARTZ LATITE	JTf	2060'	Red-brown quartz latite flow.
				DACITE			Gray dacite flow.
				BASALT			Purple basalt flow.
			Unconformity	QUARTZ LATITE			Purple quartz latite flow.
	JURASSIC (?)		AZTEC SANDSTONE		Ja	1975'	Predominantly massive orthoquartzite. Medium-to very-coarse-grained and moderately well-sorted sandstone. Relatively small carbonate boulder-breccia lens near base of exposed section. Named by Hewett (1931, p.35).
			Normal Fault				
PALEOZOIC	PENNSYLVANIAN TO PERMIAN		BIRD SPRING FORMATION		IPbs	2950'	Consists mainly of massive interbeds of limestone, dolomitic limestone and dolomite. Thin chert-bearing limestone zones near base and middle of section. Thin beds of sandy limestone. Contains abundant fusulinids, and some corals of Cowhole Mountain. Named by Hewett (1931, p.21).
							Bullion Dolomite Member: Massive coarsely crystalline dolomite containing prisoid remains. Cliff-former. Anchor Limestone Member: Finely crystalline limestone with abundant chert nodules and stringer. All members and formations named by Hewett (1931, p.17).
	MISSISSIPPIAN		MONTE CRISTO LIMESTONE	BULLION	Mmc	76'	
				ANCHOR			
	DEVONIAN		SULTAN LIMESTONE	CRYSTAL PASS	Ds	108'	Crystal Pass Limestone Member (?): Fractured and bleached limestone. Valentine Limestone Member (?): Massive finely-crystalline limestone with pitted and bleached surface. Ironside Dolomite Member (?): Massive coarse-grained dolomite. Locally brecciated. Intruded by Sands Granite. All members and formations named by Hewett (1931, p.13).
				VALENTINE			
				IRONSIDE			
	UPPER CAMBRIAN TO LOWER DEVONIAN		GOODSPRINGS DOLOMITE	MASSIVE UNIT	DCg	790'	
				BEDDED UNIT		080'	Multi-colored massive dolomite. Massive to thin-bedded dolomites, limestone and dolomitic limestones. Occasional elongated chert nodules and well-developed stringers. Unfossiliferous. Named by Hewett (1931, p.11).
			Playground Thrust				
	LOWER CAMBRIAN (?)		PROSPECT MOUNTAIN QUARTZITE		Cpm	3140'	Interbedded dolomite, quartzite and slate in nearly equal proportions. Unfossiliferous. Named by Hague (1892, p.419).
			Unconformity				
	PRECAMBRIAN		BASEMENT COMPLEX		pCg		Gneiss, granitic gneiss, mica schist and quartzite.

STRATIGRAPHIC COLUMN OF THE NORTHERN PORTION OF OLD DAD MOUNTAIN QUADRANGLE, SAN BERNARDINO COUNTY, CALIFORNIA

SYMBOLS

Contact — *Dashed where approximately located*

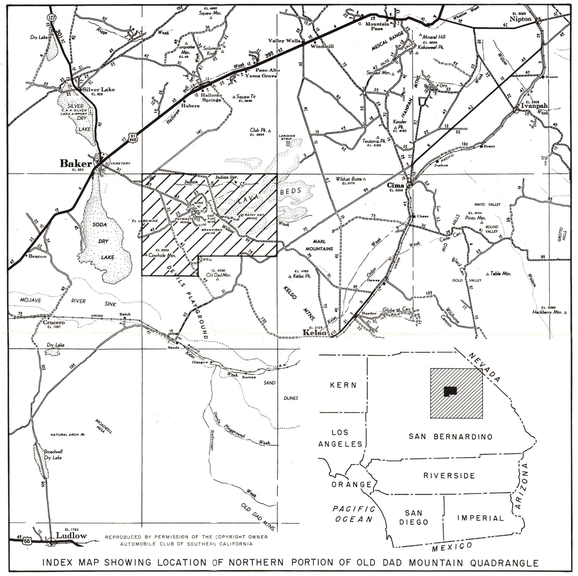
Axis of anticline

Thrust fault — *Barbs on upper plate; dotted where concealed*

Strike and dip of beds

Strike and dip of foliation

Fault, showing dip — *Dashed where approximately located, dotted where concealed*
U, upthrown side; D, downthrown side



INDEX MAP SHOWING LOCATION OF NORTHERN PORTION OF OLD DAD MOUNTAIN QUADRANGLE

Oblique aerial photograph showing part of the Quaternary ca basalt flows and cinder cones in the northern portion of Old Dad Mountain quadrangle. Dark gray hills in the upper central half of the photograph consist of Precambrian gneiss; light gray hills in upper right corner are Teutonia Quartz Monzonite. Black flow in the foreground is the youngest in the area, having extended onto the alluvium after breaching a cinder cone to the right of the picture. Note cinder cone just north of this flow. View is toward the north.