CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
416 W. Congress St., Suite 100
Tucson, Arizona 85701
520-770-3500
http://www.azgs.az.gov
inquiries@azgs.az.gov

Mohave Project

APPLIED GEOLOGIC STUDIES INC.

MOJAVE PROJECT

A Regional Tectonic-Metallogenic Study of Parts
of Bakersfield, Los Angeles, Trona, San Bernardino,
Santa Ana, Kingman, Needles, Salton Sea, and El Centro
1° x 2° sheets, southern California

Prepared by

Robert T. Wilson,

William A. Rehrig and C. Jean Cone

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SUMMARY AND CONCLUSIONS

The Mojave study area is a known gold province. Within the study area, two districts have had historical production in the 750,000 to 1 million ounces of gold; five others have produced greater than 150,000 ounces of gold; and several more have had production in the 50,000 to 100,000 ounce range. Since the deregulation of gold prices in 1971, the rapid rise in the world gold price has resulted in renewed activity and several significant recent discoveries in old producing districts. These include:

	Deposit	Size	Grade
1.	Mesquite (Goldfields)	50-70 million tons	0.05-0.07 opt Au
2.	Colosseum (Draco & Amselco)	8 million tons (proven) 8-10 million tons (probable)	0.05 opt Au 0.03-0.05 opt Au
3.	Picacho (Chemgold)	6-7 million tons	0.05 opt Au
4.	American Girl (Newmont)	Unknown	300,000 oz. contained Au. Exploration continuing.
5.	Black Hawk	Reports circulate that a deposit containing about 100 million tons grading 0.03 opt Au has been delineated in this district.	
6.	Hart (Freeport & Noranda)	Deposit is not yet explored but has earmarkings of a major disseminated deposit.	

From such "statistics," we can with confidence state that the gold potential for the Mojave study area is justly established. The gathering and incorporation of fairly detailed structural and lithostratigraphic information from all scales of geologic reference material onto a 1:250,000 base map has provided a better understanding of the metallogenesis and mineral potential of the region. This understanding is manifest in two general ways:

a. Correlation of lithostratigraphic units across quadrangle boundaries permitting a coherent understanding of the tectonic evolution of the entire region.

b. Establishment of regional structural and lithologic controls of gold metallization in the region in a way unachievable through the use of smaller scale maps.

Computerized metals data bases (i.e. Terradata, CRIB) were used to integrate large quantities of metal occurrence data and NURE HSSR geochemistry into composite overlay maps of the same scale as the lithotectonic map. Integration of these data with the lithotectonic map, coupled with detailed analysis of same has provided important insights into the understanding of regional metallogenesis in the Mojave study area. More importantly this process has facilitated the development of exploration models that we feel offer the best chances for finding undiscovered deposits in the region of the size to interest most clients. Important findings resulting from the data integration for the Mojave region include:

a. Recognition of the previously unknown importance of the Vincent-Chocolate Mountains thrust-system to the localization of certain large bulk tonnage gold deposits and several mining districts. Examples are thought to include the newly discovered Mesquite deposit, the Picacho deposit and the Yellow Aster Deposit. These deposits as well as abundant occurrences strung out along this structural zone are believed to warrant intense exploration for similar, yet to be discovered, deposits.

b. Establishment of the importance of Miocene rhyolitic intrusive and volcanic rocks to the regional proliferation of metals occurrences, in the northern half of the study area. Recognition that certain permissive terrains into which the rhyolites were intruded offer settings similar to ones which host hotspring related disseminated gold deposits in nearby regions.

c. Determination that the impressive northwest-striking wrench fault system (i.e. Helendale fault, Linwood fault, etc.) that traverses the western and central portions of the Mojave and gives much of this region its present-day physiography has had little or no effect on metals distribution (except for possible offsets). Formation of the stress field that produced this system may have had some influence on the localization of some of the Miocene rhyolites (i.e. dike direction), but the faulting occurred largely after regional metallization.

d. Recognition that thrust faulting other than the Vincent thrust has been important in localizing some gold deposits. Several different ages of thrust faulting are recognized in the region ranging in age from possibly as old as the Antler orogeny (Devonian) to as young as Miocene in the San Bernadino Mountains.

e. Identification of an early Mesozoic oceanic (?) arc terrain of basaltic and rhyolitic rocks intruded by alkalic plutons. This terrain strongly resembles the Triassic Nicola-Takla province of the northwest Cordillera which hosts gold and copper-gold deposits of albitic affinities.

f. While some deep crustal flaws or discrete mineral belts may exist in the Mojave which influenced regional metallization, lack of necessary geologic detail in many ranges together with extensive alluvial cover destroying geologic continuity of the region precluded recognition of these features. In this respect the results of this project differ somewhat from those of the Northwest Project.

g. Indication that metamorphic core complexes are anomalously barren of mineralization, while low-angle detachment fault zones bounding them play a major role in localizing gold occurrences exterior to them. This finding is identical to that found in the Northwest study.

Further analysis of individual mining districts produced a clearer understanding of smaller scale mineral controls and resulted in the recognition of a number of individual mines that should be given further follow-up examination.

Integration of the perspectives gained through the regional analysis with the individual mining district studies has resulted in the identification of several geologic environments repeatedly occurring in the region which display an unusual "favorability" for hosting major gold deposits. This has led to the development of appropriate models of mineralization.

Finally, we feel that this study will formulate a systematic and well thought out exploration strategy which can greatly improve the effectiveness of exploration expenditures. As a result of this comprehensive analysis, we have given prioritized exploration targets within the geologically favorable terrains and districts which we feel offer the best chance for the discovery of gold deposits suitable for client. Due to the regional nature of the study, most targets are generally ball-park size, but a number of site specific mines are also included. Systematic focus and exploration on these areas utilizing the proposed geologic models, will, in our minds, put client a major step ahead of competition entering the area. Prioritized target areas include:

1. The regionally extensive Vincent-Chocolate Mountains allochthon, with special focus on the following districts and areas (see map Overlay 7).

a. Chocolate Mountains
b. Dos Palmas
c. Dunlop Acres
d. Mount Baldy
e. Acton
f. Rand

2. Terrain displaying disseminated hotspring type deposit potential.

a. Lanfair Basin
b. Rand
c. Jawbone Canyon
d. Loraine
e. Mojave
f. Other favorable areas

3. Thrust faults other than Vincent thrust.

a. Doble (Black Hawk) thrust
b. Clark Mountains
c. Other miscellaneous thrusts

4. Prophyry-type copper-gold in albitized Triassic volcanic and intrusive rocks.

a. Ord Mountain district.

5. Epithermal propylitic and carbonate-silica hotsprings mineralization associated with metamorphic core complex detachment zones.

a. Copper Basin - Whipples
b. Savahia Peak - Whipples
c. West side of Sacramento Mtns.

6. Miscellaneous mines not in above-mentioned districts.

a. Lucy Gray
b. Hercules
c. Golden Bee
d. Red Cloud
e. Tumco
f. Sky Blue
g. Atwood Clay
h. Pine Tree
i. Yellow Treasure
j. Iron Chief
k. Desert Queen

Numerous other individual mines or mineralized areas are "flagged" under the descriptions of individual mining districts.

RECOMMENDATIONS

While gold mining districts and occurrences are numerous and widely scattered across the study area, the magnitude of the desired target size (1 million ounces of gold) precludes from interest most of the deposit types (i.e. individual veins) commonly encountered in the region. With this criteria in mind we have focused on several distinct geologic environments that occur within the region and which exhibit a characteristic "permissiveness" or proper geologic setting in which major bulk-tonnage gold deposits can, and do, exist. In our minds, the two single-most important settings or deposit classes in the Mojave region in which client size targets occur are those associated with the upperplate of the Vincent-Chocolate Mountains allochthon and volcanic-related hotsprings types.

There are no shortcuts to proper Phase 2 follow-up studies. In order to utilize to full advantage the results and exploration concepts presented in this Phase 1 tectonic-metallogenic analysis, comprehensive and systematic evaluation work is required in the priority areas outlined. Exploration follow-up should pursue slightly different paths for the different targets or "settings," but basically should consist of reconnaissance examination and evaluation, mapping and sampling. Mapping and sampling should be conducted on 1:62,500 or 1:24,000 scales with the result of this work leading to specific property evaluation and land acquisition. While Phase 2 work is manpower intensive it is relatively inexpensive when compared to later land acquisition and drilling costs.

A suggested formula for first-order Phase 2 exploration work for the main target types follows:

a. For the Vincent-Chocolate Mountains allochthon model, immediate follow-up consisting of reconnaissance mapping and sampling needs to be conducted in all the gold-bearing areas in upperplate crystalline rocks in close proximity to the thrust zone. Special attention should be given to areas displaying intrusive activity and stockwork or pyritization in cataclastic rocks within this zone. While much potential obviously exists in the Chocolate Mountains-Picacho area, this region is rapidly being inundated by competitors. Much less competition will probably be encountered in other favorable areas such as the Mount Baldy, Dos Palmas and Acton districts. The Mount Baldy area, for example, may have once been juxtaposed to the Chocolate Mountains before being offset along the San Andreas fault.

b. In the Tertiary volcanic and sediment terrains deemed permissive for hosting hotspring related gold deposits, a somewhat different approach is recommended. Since these deposits are often associated with visably noticeable argillic alteration zones, we recommend that low-altitude airplane or helicopter reconnaissance first be conducted in the targeted regions. Obvious areas of argillic bleaching, silicification, etc. could then be immediately designated for reconnaissance mapping and sampling. Observation should be particularly focused in the vicinity of rhyolitic intrusions in the targeted area. The volcanics in and around the Lanfair basin should be given the first priority as disseminated mineralization and widespread silicification existing in these rocks is currently perpetrating a land rush in this region. Areas with good potential may still exist in this prospect area, but they won't be around for long.

In an area where ground cover or poor exposure renders low-altitude flying ineffective, reconnaissance mapping and geochem-sampling should be conducted. Again, particular attention should be paid to those areas exhibiting silicic intrusive activity or vent areas.

c. Where we have targeted other mineralized thrust zones (i.e. Black Hawk and Clark Mountains), follow-up in most cases should be of specific mines or gold occurrences on these structures (i.e., Morning Star mine in Clark Mountains; American mine in Bullion Mountains). The one exception is the thrust faulting exposed in the northern San Bernardino Mountains (Black Hawk, Baldwin Lake and Holcomb Valley districts). Enough significant mineralization is exposed along this structure to warrant immediate reconnaissance sampling and mapping along its entire exposure.

d. As a result of our district analysis a number of individual mines or occurrences drew our attention for various reasons. Such criteria as past production, structural preparation, stockwork veining, alteration, etc. were of sufficient interest in these cases that we have targeted them for specific evaluation. Some of the most interesting of these mines are listed under part 4 of the Exploration-Target Delineation section of this report. Others can be found in the Mines of Interest section within the individual district summaries.

Also defined are some longer-ranged, more grass-roots type of targets that we feel deserve attention in the study region. These include the precious metals mineralization associated with the metamorphic core complex detachment faults and associated hydrothermal activity. More documentation of this subject has been treated in a topical report by Rehrig (1983).

The other grass-roots target entails the possible potential for "porphyrystyle" Au-Cu mineralization in the albitized and hydrothermally altered rocks of the Sidewinder and Ord Mountain Volcanic Series in the south-central portion of the study area. The geologic setting of these rocks is not unsimilar to certain terrains in Canada and northwestern U.S. where disseminated and stockwork gold mineralization is associated with albitized porphyries.

Thus, with the conclusion of this Metallogenic-Tectonic analysis, the client is provided with a detailed and comprehensive data base which could provide several years of intelligent exploration. While further treatment of the metal occurrence and NURE HSSR geochemical data could be accomplished, we feel that the findings presented herein are sufficient, if acted upon, to delineate and acquire favorable property positions for precious metals deposits within a reasonably short period of time (i.e. $<$ 1 year).

TECTONIC OVERVIEW

Introduction

A synthesis of the Mojave Province is particularly difficult for the following reasons: (1) discontinuous exposures separated by wide expanses of alluvium; (2) lack of modern geologic mapping over large areas; (3) tectonic position of the province during pre-Cenozoic time adjacent to both Cordilleran and Ouachitan margins of the North American craton; (4) the effects of what appears to be a gigantic Laramide underthrusting event wherein much if not all pre-Tertiary exposure of the province is allocthonous; and, (5) major lateral displacements related to the San Andreas and Garlock fault systems. For these reasons the reconstruction described here can only be considered rudimentary at best. Heavy reliance is placed on regional references such as Burchfiel and Davis (1981) and Dickinson (1981), who have synthesized data from many workers.

In the map series which accompany this report, Overlay 2 emphasizes major tectonic features of the Mojave Desert, many of which are discussed in this section. Overlays 3 and 8 show specific Tertiary tectonic features which are relevant to the exploration for Tertiary metallization.

Precambrian

Although exposures of Precambrian igneous and metamorphic rocks are relatively abundant, little is known concerning detailed history of these rocks. Precambrian outcrops include voluminous granitic batholiths, volcanics and metamorphic belts. The consolidation of the Mojave basement appears to have occurred about 1.7 b.y. ago and was later intruded by widespread granites about 1.4 b.y.B.P. These events and their characteristic lithologies (i.e. 1.4 B.P.

alkali, megacrystic granites) are typical North American assemblages and so it is assumed that the Mojave was part of the mid-Proterozoic, transcontinental basement arch. By late in the Proterozoic, rifting and subsequent continental drift carved out the North American continental block as we now know it. The exact time of Proterozoic rifting is not known with certainty; yet, the syenites, mafic alkalic rocks, and carbonatites intruded into basement from about 1.4 to 1.2 b.y. b.p. may indicate the inception of continental rifting.

The Pahrump Group (or Series) found primarily in the Death Valley region, attains thickness of over 2 km. and are the oldest unmetamorphosed sedimentary rocks to lie on basement crystalline rocks. Their aulacogenous character is similar to thick, late Precambrian sediments elsewhere through the Cordillera (i.e. Belt in Montana-Idaho, Uinta Group in Utah) which were deposited in rifted basins or along the rifted margin of the continent. The tectonic environment was acompressional or extensional with the early intrusion of extensive basic sills and dikes. These intrusions which date at or before 1 b.y. help establish the period of sedimentation of Pahrump-like deposits from about 1.3 to as young as 850 m.y. (Stewart, 1978).

Late Precambrian sedimentary rocks of the San Bernardino Mountains, the Big Bear Group, could possibly be a time equivalent as well as a lithologic equivalent of the Pahrump Group which would lend support to a slope or breached slope depositional environment. If these units are lithologic equivalents, the possibility exists that an aulacogen need not be invoked to explain Pahrump sedimentation.

Paleozoic

Throughout the early Paleozoic, passive subsidence allowed conformable successions of shelf sediments to accumulate across broad belts flanking the North American craton. In the Mojave Desert these early Paleozoic sediments are represented by a westward thickening wedge of miogeoclinal rocks. Of major significance is the fact that North American, shelf-miogeoclinal, Paleozoic facies are found across the nearly entire E-W transect of the Mojave terrain, except for scant occurrences of slope or eugeosynclinal facies rocks found north of Victorville and in the El Paso Mtns. These strange sequences appear decidedly out of place within the cratonal miogeoclinal Paleogoic setting of most of the Mojave.

In the far west in the Victorville area, the early Paleozoic rocks as indicated have a "cratonal" nature. Ordovician through early Devonian rocks are missing (Miller, 1981). The absence of these early miogeoclinal rocks suggests that this area of the southwestern Mojave Desert was positive, or was in some other manner excluded from the sequence of events common to the eastern Mojave Desert and southern Great Basin.

Dickinson (1981) indicates that during the early Paleozoic, between the Cordilleran and Ouachitan margins, the transcontinental arch formed a projection of Precambrian basement that extended southeast from the core of the craton. This prong of Precambrian basement reaches across what is now the southern Cordillera into the heart of the circum-Pacific orogenic belt. In southern California, Precambrian basement rocks extend nearly to the shores of the Pacific. There is thus reason to wonder whether North America may once have extended some indeterminate distance to the southwest. The general continuity of the belt of lower Paleozoic shelf and platform sediments, from Texas west across Arizona, suggests that the Cordilleran and Ouachitan rifted margins were connected around the end of the transcontinental arch prior to Mesozoic tectonic events in Mexico. The complexity of tectonic overprints in Arizona, however, and the paucity of data on the Paleozoic of Mexico makes the nature of the connection still uncertain. Near the end of Devonian time, the Antler orogeny along the Cordilleran margin deformed the outer flank of the miogeocline in Nevada, and thrust the Roberts Mountains allochthon of generally oceanic facies above the miogeoclinal strata from west to east. Emplacement of the Roberts Mountains allochthon imposed a tectonic load that depressed the edge of the continental block. Consequently, a deep foreland basin developed on top of the remaining undeformed portion of the miogeocline lying east of the thrust front. Early Pennsylvanian deposits of cherty limestone generally characterize sedimentation within this basin. Locally, within the basin, terrigenous clastics formed deposits like the Battle and Tomera Formations in Nevada. Possible examples in the Mojave include the upper part of the Garlock Formation, part of the Bird Spring Formation, an unnamed unit in the Calico Mountains, and the Fairview Valley Formation.

If the Antler orogeny was the result of an arc-continent collision, the overthrust allochthon can then be interpreted as the subduction complex of an arriving arc-trench system, beneath which the miogeoclinal assemblage was underthrust by subduction. Recent information suggests that similar allochthonous terrains were emplaced in analogous fashion farther south, both in the Mojave region and in central to southern Sonora. Burchfiel and Davis (1981) indicate that some sediments of the Garlock and Coyote Group found in the El Paso Mountains and Lane Mountain area are similar to slope or rise facies exposed in the Roberts Mountains allochthon.

As previously indicated, these near-eugeosynclinal facies are tectonically displaced from their original sites of accumulation. It is unclear how they have been transported, but suggestions of large left-slip faulting in Permo-Triassic time (Burchfiel and Davis, 1981) and equally major displacements along the Mojave-Sonora megashear (Dickinson, 1981) during Jurassic time have been proposed. Evidence for mid-Paleozoic deformation is also found in the El Paso Mountains, where deformed Devonian and older Paleozoic rocks in the Garlock Series are unconformably overlain by Mississippian and fossiliferous Permian rocks belonging to the middle part of the Garlock Series. The deformed lower Paleozoic rocks are probably part of the Antler terrain that was thrust eastward onto the continental shelf in early Mississippian time and unconformably overlain by the younger Paleozoic overlap assemblage (Burchfiel and Davis, 1981).

In Late Permian and earliest Triassic time the Sonoma orogeny was initiated by an arc-continent collision along the Cordilleran margin. An extensive composite arc terrain was sutured to the Cordilleran margin with local magmatism occurring during or just after the collision event (Dickinson, 1981). Recent work in the Mojave region indicates that major deformation, metamorphism, uplift, erosion, and deposition of both synorogenic and postorogenic clastics occurred in association with the Sonoma orogeny. Plutons of permo-Triassic age are also known in the Victorville-San Gabriel-San Bernardino region (Burchfiel and Davis, 1981). Thrusting was probably not restricted just to the Nevada area. Thrusts in the northeastern Mojave have generally been considered of Cretaceous age, yet they are intruded by arc plutons now known to be of Early Jurassic age implying that the structures are related to Sonoman deformation.

Mesozoic

The Mesozoic tectonic history of the Mojave Region departs drastically from that governed by the continent-margined miogeocline which developed during the Paleozoic. Most all Paleozoic rocks found in the region have distinct North American affinities. In contrast, Mesozoic rock units reflect the disruptive effects of volcanism and plutonism within a shifting magmatic arc (continental and oceanic) of Andean type. The arc assemblages accumulated along and oceanward of the continent and then were sutured to and thrust upon North American basement prior to middle Tertiary time. Forearc, continental detrital sequences, and volcanics were deposited east of the main Mesozoic orogen.

Along the Cordilleran margin, subduction of seafloor and resultant arc magmatism initiated the modern circum-Pacific orogenic system. The oldest widespread plutons of the Mesozoic magmatic arc that intrude Precambrian basement and its Paleozoic cover in the southern Cordillera were emplaced about 150 to 190 m.y.B.P. Scattered plutons of Late Triassic or older age are known locally in the Mojave region, and bi-modal(?) volcanics of Late Triassic age are locally prominent. Units such as the Sidewinder volcanics, which are fairly mafic and perhaps alkalic, may indicate an offshore oceanic arc of rift(?) affinity similar to rocks of Wrangalia or Nicola-Takla terrains farther north along the Cordillera.

East-directed thrust faults developed east of the Triassic arc. In the northeastern Mojave these thrusts are associated with folded rocks as young as Early and Middle Triassic and are intruded by plutons 180 m.y. old. Similar thrusts found in southeastern California are cut by plutons 200 m.y. old (Burchfiel and Davis, 1975).

The Mid-Lower to Mid-Upper Jurassic granitic batholiths and associated arc volcanics form an elongate belt extending from the Sierra Nevada region to northern Mexico. Although rocks of the Jurassic arc terrain are displaced locally across the Mojave-Sonora megashear (Silver and Anderson, 1974), arc magmatism continued southward in Mexico. Subduction continued beneath both sides of this postulated paleotransform, but the Jurassic arc appears to have crossed obliquely from continental crust in southern Arizona to oceanic crust northwest of the Mojave. Deformation along the arc or within the forearc region may have given rise to local uplifts or pull-apart basins in southern Arizona and the Mojave region (Dickinson, 1981). The McCoy Mountains Formation as described by Harding (1981) and Harding and Coney (1983) may be an example of a sedimentary package deposited in one such pull-apart basin.

Laterally extensive eolian units developed east of the forearc region but were blown southward away from the shoreline trend. These terrigenous sediments are considered analogous and generally correlative to strata intercalated with Jurassic arc volcanics in the central and eastern Mojave region.

As subduction continued through Mid-Late Jurassic time, oceanic island arc terrain(s) were accreted to the North American continent. Suggestion has been made that lodging of these arc terrain blocks in the active subduction zone induced subduction to migrate westward. By whatever mechanism, the zone of subduction appears to have migrated westward throughout latest Jurassic and Cretaceous time. The subduction complex grew laterally and in thickness concurrently with the development of forearc basins at intervals along the arc-trench system. The magmatic arc occupied a belt within which major composite batholiths were emplaced in the Sierra Nevada and the Peninsular Range during Jurassic to Cretaceous time (Dickinson, 1981). Many of these plutons are represented in the Mojave province which helps establish the Mesozoic continuity between Sierran and Peninsular provinces.

The Rand, Orocopia and Pelona schists occur as a lowerplate lithology beneath the Vincent-Chocolate Mtn. thrust and overlying crystalline basement rocks through a wide portion of the Mojave. Tertiary uplift of the Mojave region has exposed portions of this unit along the Vincent thrust, at many localities.

Although sharing many lithologic similarities with the Franciscan subduction complex of California, Haxel and Dillon (1978) cite reasons to suggest that the two trench(?) assemblages are not related. Although the Franciscan is mid-Mesozoic in age, the age of the Pelona-Orocopia is still unresolved, and may even be Precambrian (Bennet and De Paelo, 1982).

Currently there is insufficient data to account for the origin or tectonic emplacement of the Vincent-Orocopia terrain beneath North American basement. Suggestions of: (1) low-angle subduction and underthrusting of trench rocks; (2) overthrusting of "exotic" continental slabs (Ehlig, 1981); and, (3) back-arc, ensimatic basin closed and overthrust by late Mesozoic compression (Haxel and Dillon, 1978), have been made.

By latest Cretaceous and early Paleocene, Laramide compressional deformation extended throughout the southern Cordillera and east beyond earlier Cretaceous basins (Dickinson, 1981). Accompanying arc magmatism shifted eastward and decreased in intensity. Crustal shortening was accommodated by deep seated and shallow thrusting, major folding--even nappe-like structures (Hamilton, 1982), and emplacement of the Vincent-Orocopia thrust system. Deeper thrusts display well developed mylonitic fabrics with NNE to NE (or SSW to SW) direction of tectonic transport. Thrusts in the Mojave and in western Arizona commonly place Precambrian or Mesozoic crystalline rocks atop Mesozoic-Paleozoic sedimentary sequences. This compressional climax appears generally related to low-angle subduction of the late Laramide orogeny.

Thermotectonic upwarping and increased crustal ductility of the southern Cordillera was followed by emplacement of major dike swarms and unique, crustally derived two-mica granites, during late-Cretaceous to earliest Eocene time. The presence of garnets as well as aluminum-rich biotite plus muscovite in these granites may indicate a relatively great depth of formation and crystallization.

The two-mica granites as described by Miller (1981) are strongly peraluminous granites (SPG) and are grouped in a narrow belt from Sonora to British Columbia. The belt lies at the western edge of the ancient Precambrian craton and is spatially related to a Phanerozoic regional metamorphic belt which includes the Corilleran metamorphic core complexes.

Origin of the two-mica granites may involve anatexis of ancient quartzo-feldspathic para- and/or orthogneiss. Melting reactions in weakly metaluminous to weakly peraluminous gneisses would partially explain the strongly peraluminous magma compositions. Restriction of the granites to the Precambrian craton suggests: (1) a crustal discontinuity resulting in development of conditions conducive to crustal anatexis; or, (2) that the nature of fusible crustal material changes at the craton edge (Miller, 1981).

It should be noted that the two mica granites occur prolifically in upper- and lowerplate(?) positions of the Vincent-Orocopia thrust. Many of these unusual magmas, especially those in Arizona, appear to have originated during late Laramide (55-45 m.y.B.P.) low-angle subduction when normal, calc-alkaline magmatism (granodiorites) was quiescent.

Tertiary

By 40 m.y.B.P., the profound, structural, metamorphic and magmatic events of the Laramide orogeny had ceased. Potassium-argon numbers from widespread plutonic and metamorphic outcrops through the Mojave and Sonoran Desert terrain fall from about 60 to about 45 m.y., indicating that the whole region had cooled and uplifted through that time interval. In Arizona a newly recognized Eocene (50+ to 45 m.y.) two-mica magmatic epoch is filling the "magmatic gap" defined earlier by Damon (1968), but dating of these rocks in the Mojave is insufficient to tell how many of these Eocene-Paleocene granites are mixed with Cretaceous equivolents which are known there.

Beginning no earlier than 35 m.y.B.P., a widespread burst of generally intermediate, calc-alkaline volcanism and intrusion affected the Mojave block. The activity ended about 20 to 22 m.y.B.P. and was replaced by primarily basalt or basalt-rhyolite volcanism from about 19 m.y. in the western desert to 13 m.y. along the Colorado River. A late sequence of andesites occur over basaltic flows in some areas of the Mojave which have not been petrogenically explained.

Generally, the entire span of Tertiary magmatism corresponded with extreme crustal extension after the equally intense shortening and ductile compressional processes of the Laramide. During the 35 to 20 m.y. interval, the extension was thin-skinned and directed horizonally (Rehrig, 1981). Volcanic and volcano-clastic sequences correlate with tilting and listric fault fragmentation, some of which occurred on flat detachment faults in the central and eastern Mojave regions (Dokka, 1981; Teel and others, 1982; Davis and others, 1980; Spencer and Turner, 1982; Berg and others, 1982; Lyle, 1982; Jorgensen and others, 1982). Thermal as well as an undetermined amount of mylonitic activity of Oligocene-Miocene age are represented in the Whipple and Chemeheuvi metamorphic core complexes.

These tectonic effects, both ductile and brittle, of the mid-Tertiary extensional orogeny correlate closely with a burst of calc-alkaline magmatism which extended nearly synchronously across 1000 km. of the southern Cordillera. The orogeny may have resulted from severing and flounder of the flattened (during Laramide) subduction zone which triggered widespread melting and asthenospheric diapirism (Rehrig, 1983).

Thick squences of later Tertiary volcanics and continental sediments accumulated in fault controlled basins. These elongate basins include the Cajon, East and West Antelope basins north of the San Andreas fault, the Kramer and Barstow basins in the central Mojave, and the Mojave and Koehn basins near the Garlock fault (Overlay 3).

It is now estimated that initial Farallon-North American plate collision occurred opposite the present Transverse Ranges of southern California sometime during the interval 21-29 m.y.B.P. (Murray, 1982). Since that time, faulting in the Mojave block has been controlled by either lateral strike-slip shear related to the San Andreas-Garlock transform structures, or pull-apart tensional stresses secondarily related to the wrench tectonics.

LITHOTECTONIC UNITS

The following is a full description of tectonic units used in construction of the Mojave lithotectonic map. The order of discussion is generally from oldest to youngest with the exception of the introductive section on the enigmatic metamorphic core complex. Numerous references are contained in the description to mountain ranges of the study region. These geographic features are shown in Plate 2.

MCC Metamorphic Core Complexes, Lowerplate

Metamorphic core complexes (MCC) have been recognized in the Whipple, Chemuhuevi, Riverside, Sacramento and Dead Mountains (Fig. 1). Detachment faults similar to those associated with known MCC (Crittenden and others, 1980) have been defined in the Homer Mountain area, and the Arica, Big Maria, Newberry, and Midway Mountains; however, recent field work by Rehrig has raised serious doubt regarding the existence of detachment faults in the Riverside, Newberry, and Midway Mountains.

dome-like features formed in the extensional environment of the middle Tertiary. They have a central crystalline core of plutonic and/or high-grade metamorphic rocks, most frequently quartzofeldspathic gneisses which are overprinted by a mylonitic foliation containing a distinctive lineation. The trend of this lineation is generally consistent over entire mountain ranges or regions. Near some edges of the core, the mylonitic rocks grade into a detachment zone characterized by chloritic breccia and detachment fault. The zone is a major, low-angle structural feature of regional permeability to low temperature hydrothermal fluids.

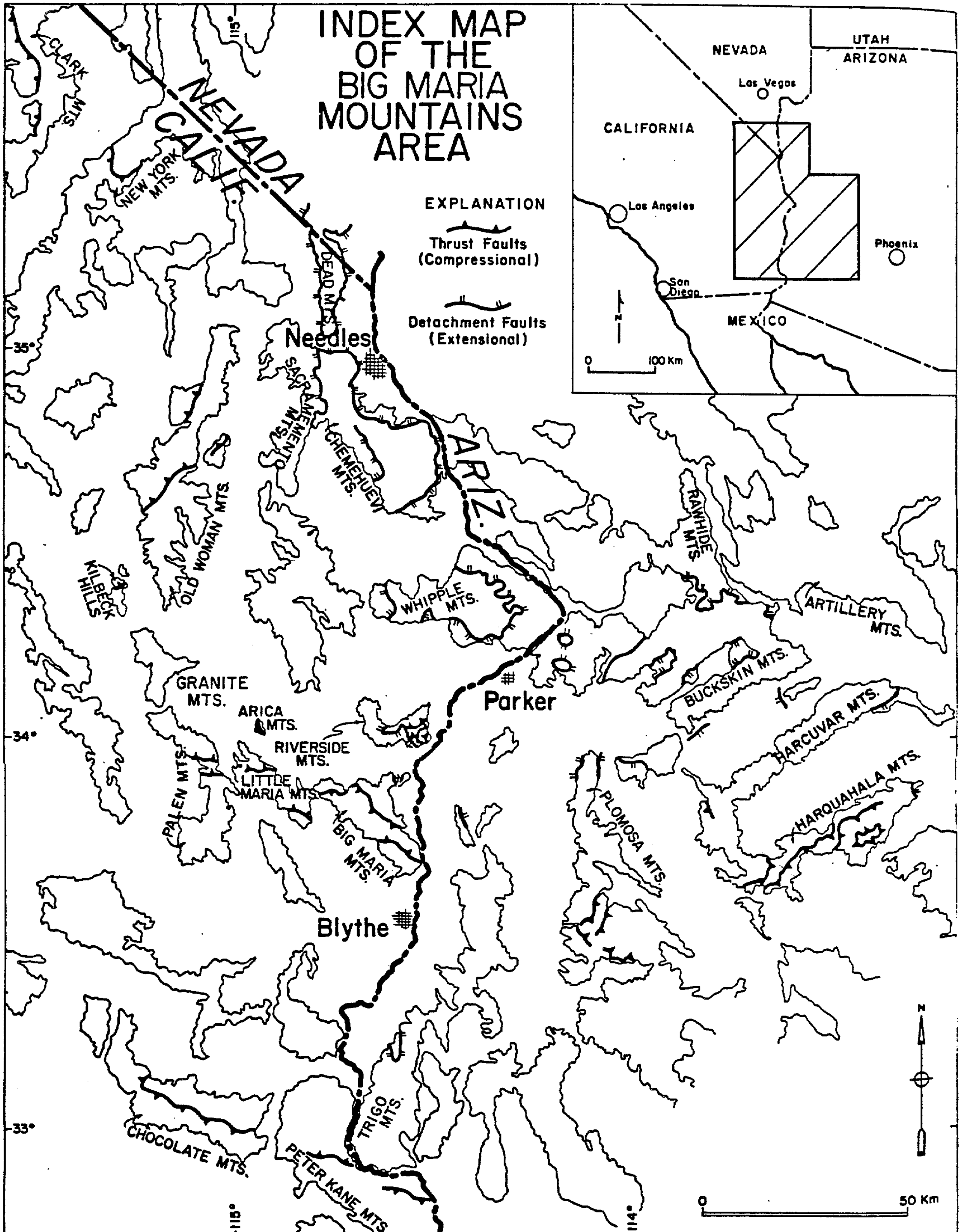


Figure 1. Detachment faulting related to metamorphic core complexes in the southeastern California and southwestern Arizona region (after Hamilton, 1982).

The chloritic breccia is associated with and overlain by the detachment surface or decollement above which is an assortment of tilted and rotated rocks. These upperplate rocks, ranging in age from Precambrian to middle Tertiary, generally lack mylonitic fabric or metamorphic texture and are cut by numerous high-angle and listric normal faults.

Geochronologic studies suggest a prolonged geologic history for the lowerplate plutonic and metamorphic rocks. The age of the magmatic rocks, of the metamorphic protoliths, and of metamorphism can range anywhere from Archean to middle Tertiary, but the dominant episode appears to have occurred from Jurassic to late Cretaceous time. Degree of metamorphism is variable ranging from high-grade, kyanite-sillimanite-bearing, quartzofeldspathic gneisses to moderate-grade amphibolite facies. The granitic plutons are of special interest as some have been described as being of the two-mica garnet-bearing type which suggests crystallization at depths of greater than 10 km (Hamilton, 1982). The final cooling of the crystalline core (± 20 m.y.) and movement on the detachment surface (± 16 m.y.) have been documented. A Tertiary age for the mylonitization event is indicated for some complexes and can be inferred for many others excluding the Mojave and westernmost Sonoran provinces where Laramide-age mylonites have been identified (Coney, 1980; Rehrig, 1982).

Within the Mojave province, support for pre-Oligocene mylonite formation (late Cretaceous to early Tertiary) is based on: (1) isotopically dated mylonitic clasts from Oligocene-Miocene fanglomerates; (2) discordance between mylonitic foliation and detachment fault; (3) inferences of a metamorphic-deformational environment too deep and intense to be reasonably attributed to mid-Tertiary processes (Rehrig, 1982).

Precambrian

pCm/pCi Early Precambrian Metamorphics and Plutons

General

Early Precambrian crystalline basement rocks crop out in many of the mountain ranges within the Mojave and adjacent Basin and Range Provinces of California. Until recently there has been a lack of published data on these basement rocks except for examples in the Clark, Marble, Orocopia and Chocolate Mountains. Additional recent studies completed in the past four years have developed a more complete picture of the early Precambrian.

Units included as part of the Mojave basement are:

- the Chuckwalla complex (Morton, 1966) found in the Midway Mountains.
- the Essex "series" found in the Old Woman and Piute Mountains.
- the Fenner Gneiss found in the Piute and Old Woman Mountains and scattered locations in the south-central Mojave.
- the Gold Park gabbro-diorite found in the Pinto Mountains.
- the Halloran Complex found in the Halloran Spring-Silver Lake region and scattered localities in the northeast Mojave.
- the Johannesburg Gneiss found widely distributed in the northwestern Mojave, particularly in the Rand Mountains.
- the Kilbeck Gneiss found at the southern end of the Old Woman Mountains.
- the Pinto Gneiss found in the Pinto Mountains near Twentynine Palms area.
- the Tumco Formation found in the Cargo Muchacho Mountains.
- the Waterman Gneissic Complex found throughout the Barstow-Hinkley area.

Data collected in recent studies (Cameron, 1981; Miller, 1981; Powell, 1981; Stewart, 1982; Cameron, 1982) generally indicate that the Precambrian rocks of the Mojave region were deformed and metamorphosed approximately 1.7 b.y. ago and intruded by granitics approximately 1.4 b.y.B.P. The dominant metamorphic rock type, granitic gneiss, is thought to have a sedimentary protolith as suggested by localized areas of schist, quartzite and marble. Intrusions into the gneiss of syenites and carbonatites in the Clark Mountains area and syenites and anothosites in the San Gabriel and Orocopia Mountains occurred 1.35 to 1.4 b.y. ago and 1.2 b.y. ago, respectively. Syenites intruded into the Marble and Providence Mountains area are epidote-rich with large phenocrysts of pink K-feldspar (Dibblee, 1980).

Eastern Mojave Desert

Precambrian basement terrane in the Clark Mountains, at the northeast margin of the Mesozoic Teutonia batholith, consists of amphibolite-grade metaigneous and metasedimentary rocks, including quartzofeldspathic and granitic augen gneiss, biotite-garnet-sillimanite gneiss, hornblende gneiss, and amphibolite. Geochronologic work (Burchfiel, 1981) indicates that the gneissic protoliths were metamorphosed and intruded by pegmatites approximately 1.65 b.y. ago; potassium-rich plutons and carbonatite intrusions occurred about 1.4 b.y.B.P.

Amphibolite-grade crystalline rocks crop out at Kelso Peak and in the Old Dad and Providence Mountains along the southern border of the Teutonia batholith. The rocks are generally steeply dipping with a north-trending lineation and consist of granitic gneisses, rare pelitic and other metasedimentary gneisses, and amphibolite. The granitic gneisses are most common and include both banded and augen gneiss varieties. Amphibolite occurs as dikes in the gneisses and as zenoliths in the batholith (Beckerman, 1982).

Basement rocks in the Ivanpah, Granite, New York and Soda Mountains are similar to those described above. Foliation in the gneissic rocks of the New York Mountains trends north-northwest and dips steeply west or vertical. In the Soda Mountains the contacts and foliation trend northwest. The gneiss is in near-vertical transitional contact with pre-Tertiary plutonic rocks and in sharp contact with the upper Mesozoic quartz monzonite (Grose, 1959).

In the Marble Mountains pendants of quartzofeldspathic gneiss, marble and mafic igneous rocks are contained in Precambrian granodiorite. These rocks are intruded by a granite yielding an age of 1.4 b.y. (Burchfiel, 1981).

Pre-Paleozoic, probably early Precambrian, crystalline rocks crop out over a large area in the northeastern Little Maria Mountains. The rocks are predominantly metamorphosed granitic augen gneiss with lesser amounts of schist. Large microcline porphyroblasts are found in a foliated matrix defined by the alignment of biotite flakes. Studies suggest this unit to be an equivalent to the 1.4 to 1.5 b.y. rapakivi granite forming much of the Precambrian crust in the area (Emerson, 1982). To the west, in the southeastern part of the Big Maria Mountains, a 1.4 b.y. old leucocratic, potassic granite is exposed. Mesozoic shearing and metamorphism with accompanying recrystallization and crushing have nearly obliterated the original fabric producing a leucocratic gneiss containing thin augen of potassic feldspar (Hamilton, 1982).

The Chuckwalla Complex, exposed in the Midway Mountains, is a Precambrian metamorphic suite approximately 1.7 b.y. old (Berg, 1982). The complex consists of quartz diorite gneiss, foliated hybrid granite rock, schist, and fine-grained granites that have been complexly deformed. Contacts between intrusives and metamorphics are gradational and not obvious.

The oldest rock types in the Orocopia Mountains are an augen gneiss, yielding a zircon age of 1.67 $\pm$ 15 b.y. (Crowell, 1975b), and migmatites. Blue-quartz gneiss, which has been dated at 1.425 b.y. (Silver, 1971), may once have been granulite-grade rocks but now exhibit an amphibolite-facies mineralogy. Syenite, anorthosite and related rocks in the area give ages of 1.22 b.y. Rock sequences similar to these are found in the San Gabriel Mountains to the west.

The Chocolate Mountains contain a thick sequence of amphibolite-grade augen gneiss, quartzofeldspathic gneiss, schist of both igneous and sedimentary origin, and metamorphosed mafic and ultramafic rocks and anorthosite. Dillon reports a date of 1.7 b.y. for an intrusive augen gneiss in the southern part of the range (Burchfiel, 1981). Dillon (1976) describes the Tumco Formation of the Cargo Muchacho Mountains to the west as a quartzofeldspathic gneiss with relict structures and/or compositions suggestive of sedimentary of volcanic protoliths.

Early Precambrian metasedimentary and metaigneous rocks underlie almost half of the Old Woman-Piute Range. All are strongly metamorphosed, many having undergone Mesozoic as well as Precambrian metamorphism and deformation. A porphyritic granitic or granodiorite augen gneiss, the Fenner Gneiss, is the dominant rock type in the Piute Mountains and is widespread in the Old Woman Mountains. Metaplutonic rocks including a garnet, two-mica leucogranite, are also abundant. Amphibolites, interlayered with the Precambrian metasedimentary sequence, are extensive but not abundant (Miller, 1982).

The oldest rocks in the Turtle Mountains include dark, rare quartzite, metaconglomerate, amphibolite, banded gneiss and schist. These rocks are injected and migmatized by younger Precambrian gneisses. The migmatizing granitic gneisses include leucogranite, biotite-garnet granite, and a fine-grained granite gneiss also recognized in the Sacramento and Mojave Mountains. As a group these rocks make up only five percent of the Turtle Mountains (Howard, 1982).

Western Mojave Desert

In the Rand Mountains and much of the northwestern Mojave, the Johannesburg Gneiss is the dominant early Precambrian rock exposed (DeCourten, 1979).

A stratigraphic section containing about 2,800 feet of the gneiss has been mapped near Johannesburg. The gneiss includes some layers rich in hornblende, several layers of marble, and some impure quartzite, all paralleling foliation (Dibblee, 1967).

The Waterman Gneiss crops out in the hills near Barstow, near Hinkley, and near Harper Valley. About 8,000 stratigraphic feet of this gneiss is exposed on Iron Mountain west of Barstow. The unit is prominently foliated with foliation parallel to lenses of marble and quartzite. The gneiss grades into gneissoid quartz diorite to the northwest of the thickest exposure (Dibblee, 1967).

The Baldwin Gneiss of the San Bernardino Mountains has been dated at 1.75 b.y. (Miller, 1980). This unit is a moderately well-layered biotite- and muscovite-rich quartzofeldspathic gneiss. It is thought to be partially metaplutonic in origin due to some local, highly porphyroblastic areas.

Throughout the San Bernardino and western San Gabriel Mountains area the sequence of Precambrian gneissic rocks including the Baldwin Gneiss ranges to 10,000 feet in thickness, overlies mylonitic rocks, and contains a southwest-dipping foliation. The lower part of the sequence is predominantly gneiss with a basal transition from cataclastic and mylonitic gneisses into the underlying mylonites. The upper segment is mainly gneissoid quartz diorite with zones of migmatite. Locally the gneiss is intruded by aplitic dikes and sills (Dibblee, 1967).

pCs Upper Precambrian sedimentary rocks, including the Pahrump Group

The oldest relatively unmetamorphosed sedimentary rocks unconformable to the Precambrian crystalline rocks in the Mojave are those of the Pahrump Group. These rocks are found primarily in the Death Valley region and the northeastern Mojave where they are locally more than 2 km thick. Pahrump or Pahrump(?) Group rocks crop out in the Kingston Peak area, the Silurian Hills, the northern edge of the Soda Mountains, the Avawatz Mountains, and the Nopah range. The type section is in the Kingston Mountains where approximately 7,000 feet of section is exposed. The rocks rest on basement rock in the following ascending stratigraphic order (Dibblee, 1980)(Fig. 2): the Crystal Spring Formation, consisting of conglomerate, quartzite, argillite, carbonates, chert and diabase intruded about 1100 to 1200 m.y. B.P., with an approximate thickness of 4,000 feet; the Beck Spring Dolomite, about 1,000 feet thick; and the Kingston Peak Formation, consisting of quartzite and argillite about 2,000 feet thick.

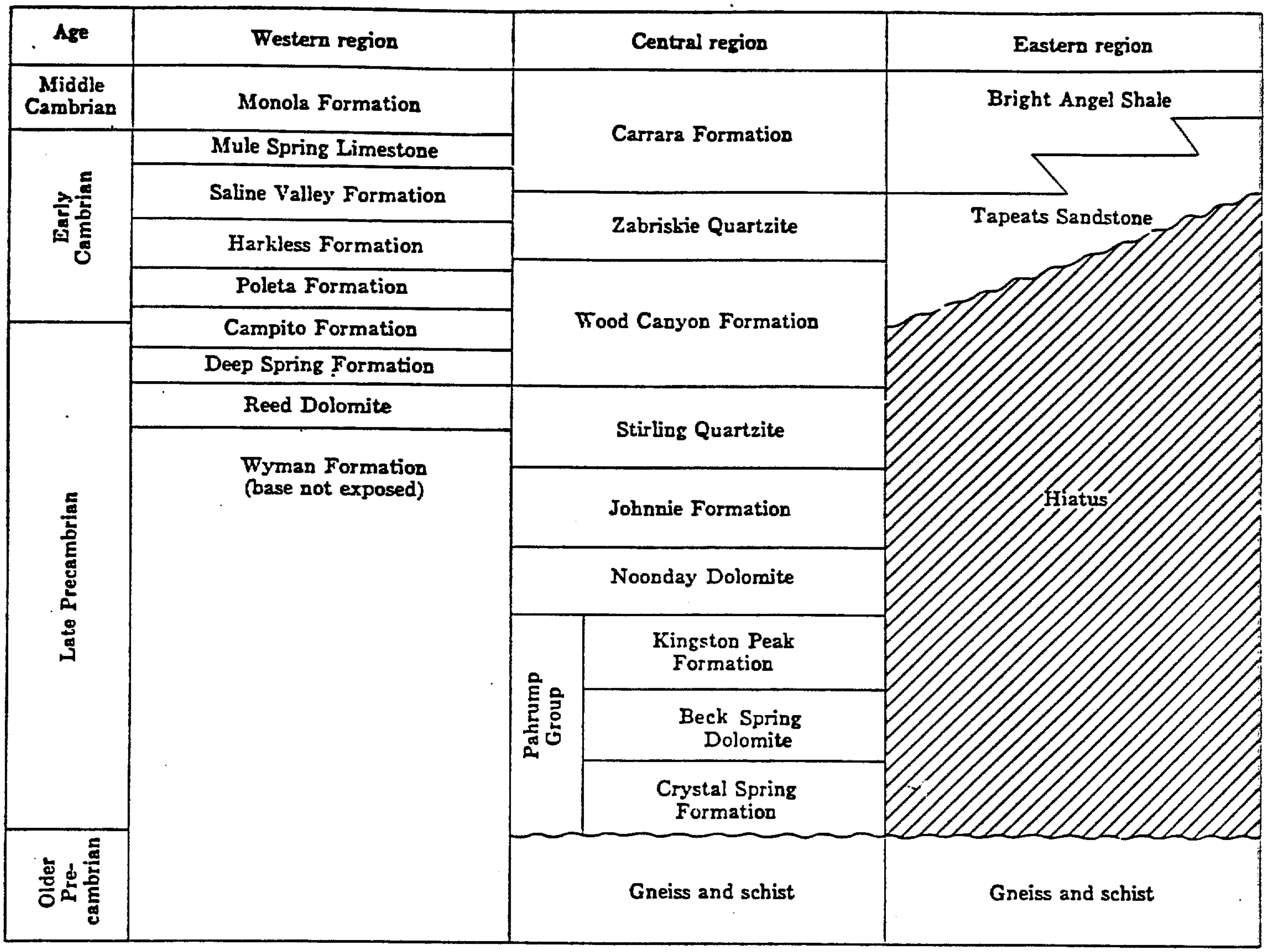


Figure 2.

Upper Precambrian and Lower Cambrian strata in the southern Great Basin. (After Stewart, 1970)

The Kingston Peak Formation of the Pahrump Group is described by Stewart (1977) as a diamictite and volcanic sequence. The distinctive diamictite (a rock composed of large clasts set in a finer grained matrix) is thought to be of glacial origin. In the Death Valley region the diamictite and volcanic sequence was apparently deposited in a fault-controlled, west-northwest trending trough, referred to as the "Amargosa Aulacogen"; only the northeast bounding faults of this trough are well documented, the southern margin is yet undefined. The main stage of subsidence is thought to have occurred during the deposition of the Kingston Peak Formation. Near the presumed margin of the formation, blocks up to 300 m in length are preserved. Debris derived from the older conformable Crystal Spring and Beck Spring Formations is contained in the Kingston Peak Formation. Several units within the Crystal Spring and Beck Spring Formations are very uniform and were possibly widespread shelf deposits. These facts suggest the underlying formations were originally widespread but were preserved in the northeast Mojave due to rapid downfaulting during Kingston Peak sedimentation.

Coarse-grained arkosic sediments at the base of the Crystal Spring Formation are the earliest depositional event in the "Amargosa Aulacogen." These sediments contain the earliest evidence for a proposed positive area, the "Nopah Uplands," along the northeast edge of the developing trough (Roberts, 1982).

The age of this sedimentation is not well defined. In the Panamint Range to the north, the rocks rest on basement intruded by plutons dated at 1.34 to 1.4 b.y. and are unconformably overlain by upper Precambrian rocks continuous in section into fossiliferous lower Cambrian rocks. The Crystal Spring Formation is intruded by diabase sills and dikes. In Arizona, diabase cutting similar rocks has been dated at 1.5 to 1.2 b.y. (Silver and others, 1977). These relationships constrain the age of the Pahrump Group to younger than 1.35 to 1.4 b.y. and older than the latest Precambrian (Burchfiel, 1981). Stewart (1982) suggests the deposition to be approximately 900(?) to 650(?) m.y. He bases this age on direct dating of greenstone found in the diamictite and volcanic sequence of northeastern Washington which produced K-Ar ages of 827 and 918 m.y.

Uppermost Precambrian sediments, unconformable to the Pahrump Group or to the Precambrian gneissic-plutonic complex, are found only in scattered isolated areas except in the northeastern Mojave Desert. These rocks form the basal section of the miogeoclinal sequence and were deposited in the initial stages of Cordilleran geosyncline development. The sequence, locally known as the Death Valley succession, extends eastward and correlates, in part, with the cratonal Grand Canyon sequence of the southern Great Basin. The uppermost Precambrian rocks will be discussed and are mapped with the Paleozoic sediments due to the lithologic similarities and unbroken sequence of deposition.

Paleozoic

Ps - Paleozoic sedimentary rocks, miogeoclinal facies

Early Miogeoclinal Units

Outcrops of uppermost Precambrian/lower Paleozoic early miogeoclinal units are found in the Clark and Nopah Mountains area, on Kingston Peak, in the Providence Mountains, the Old Dad Mountain area, on Shadow Mountain and

Quartzite Mountain in the Victorville area, and in the San Bernardino Mountains. Portions of these units are found in the Marble, Ship and Bristol Mountains. All or a portion of the following formations are included, in ascending order: the Noonday Dolomite, the Johnnie Formation, the Stirling Quartzite, the Wood Canyon Formation, the Zabriskie Quartzite, the Carrara Formation, the lower Bonanza King Formation, the Tapeats Sandstone and the Bright Angel Shale. The Tapeats Sandstone and the Bright Angel Shale are lower Paleozoic cratonal equivalents to a portion of the Johnnie Formation through the Zabriskie quartzite sequence (Stewart, 1970). The Saragossa Quartzite in the San Bernardino Mountains, the newly recognized Big Bear Group (Cameron, 1982), and the Oro Grande Formation described at Quartzite Mountain are considered western equivalents to parts of the early miogeoclinal section (Stewart and Poole, 1975)(Figs. 3 and 4).

The Wood Canyon Formation, Stirling Quartzite and Johnnie Formation were originally mapped as the Prospect Mountain Quartzite in the Kingston Mountains and vicinity. The Prospect Mountain Quartzite was later divided after correlations were made with formations found near Johnnie, Nevada, and in the southern Nopah Range.

The Hinkley Valley Complex (Miller, 1944), found in the hills near Barstow, is a metamorphosed sequence of white marble with local occurrences of phyllite or schist. The rocks have yielded no diagnostic fossils but are lithologically similar to rocks of known Paleozoic age further east (Dibblee, 1980). Little work has been done on these rocks, thus assigning them to a Paleozoic miogeoclinal or eugeoclinal facies is not possible at this time.

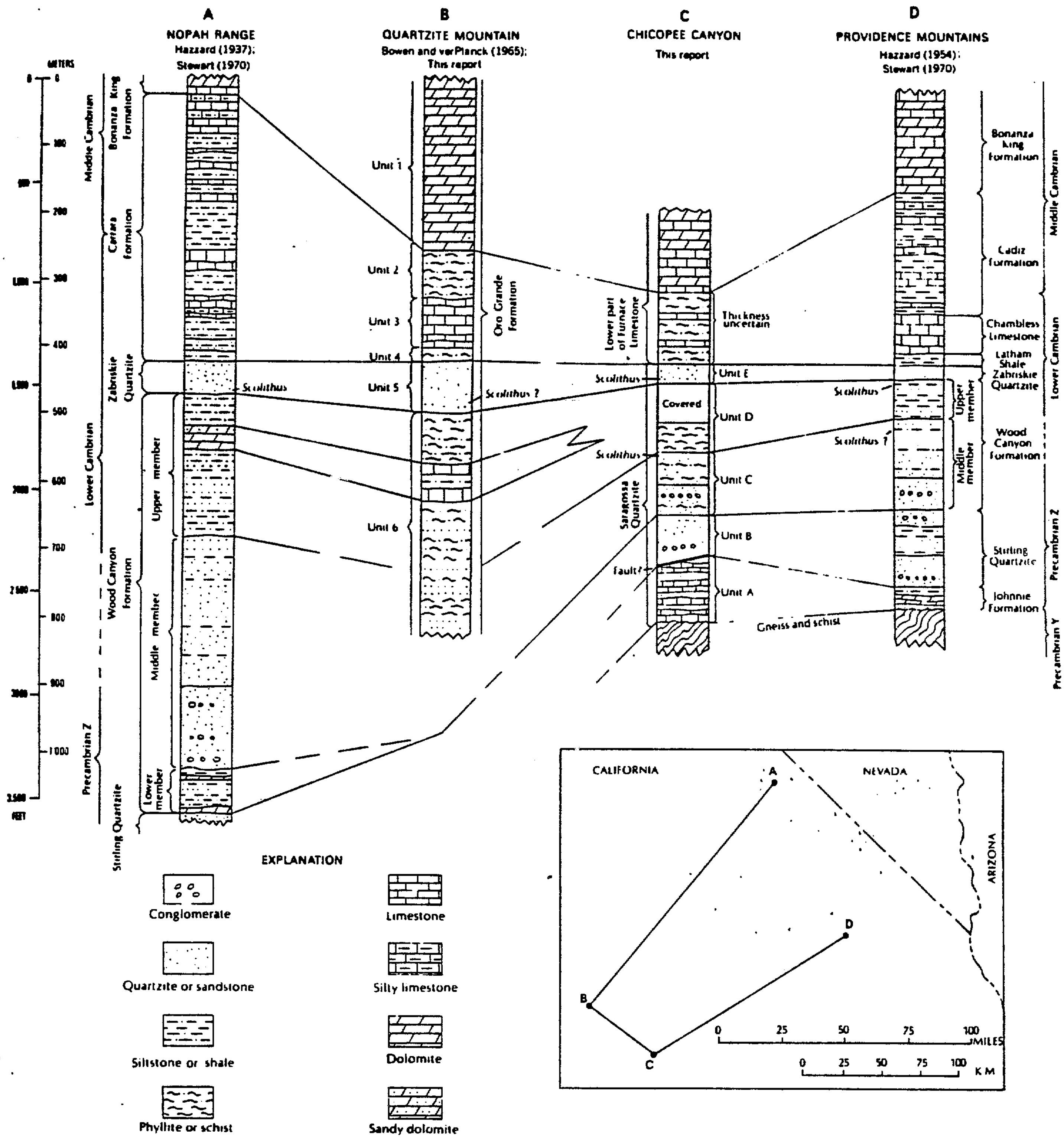


Figure 3. Correlation of strata from Chicopee Canyon in San Bernardino Mountains and Quartzite Mountain in western Mojave Desert with Precambrian and Cambrian strata in the Nopah Range in southern Great Basin and Providence Mountains in eastern Mojave Desert.

(After Stewart and Poole, 1975).

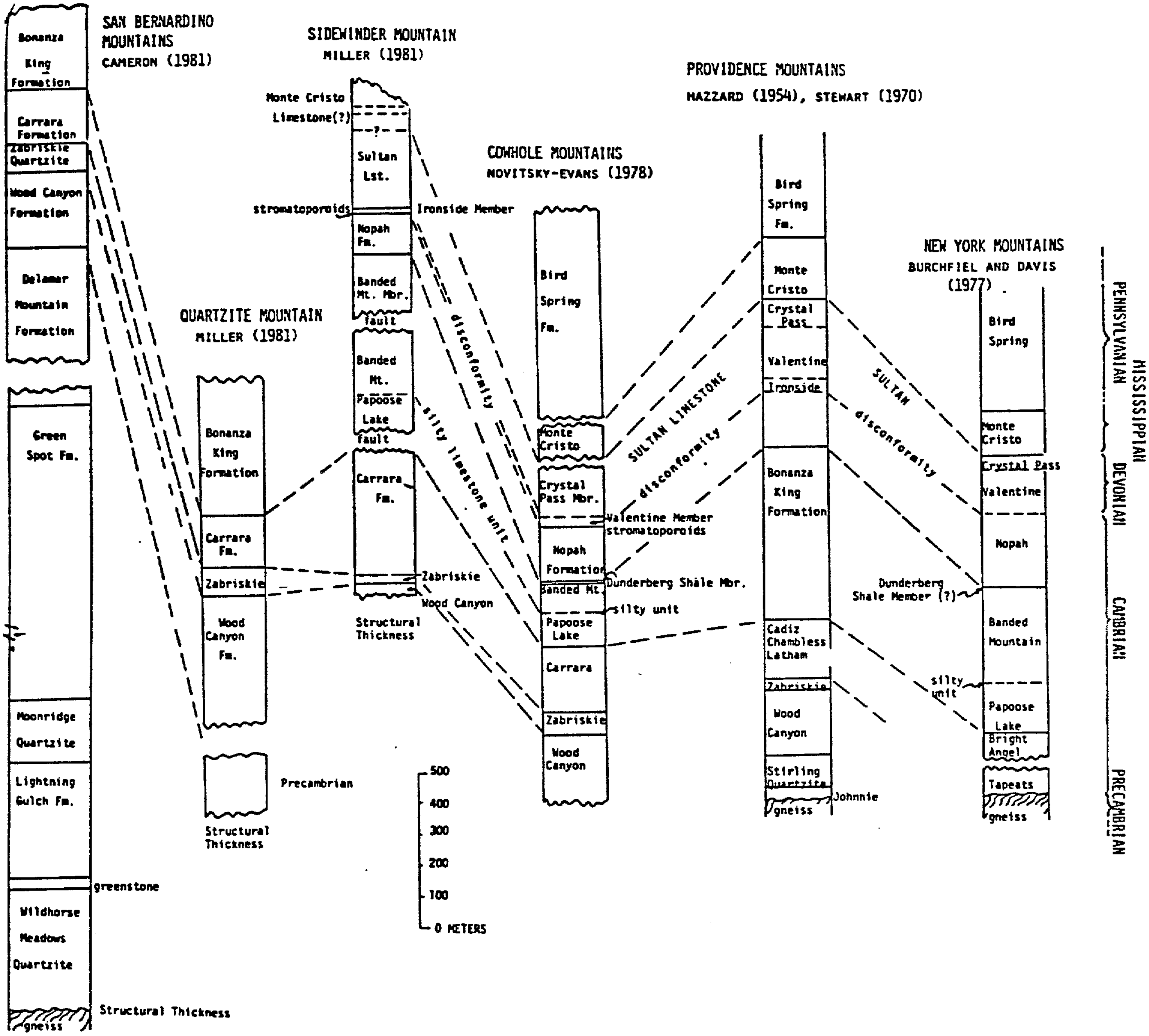


Figure 4.

Correlation of miogeoclinal strata in the San Bernardino Mountains and Victorville region to sections in the eastern Mojave Desert. (After Miller and Cameron, 1982).

The absolute Precambrian-Paleozoic boundary is as yet undefined in the stratigraphic section. The boundary is now generally considered to be somewhere within the middle unit of the Wood Canyon Formation. In the past the underlying Noonday Dolomite, Johnnie Formation and Stirling Quartzite had been designated a Lower Cambrian age. These units were reassigned to the Upper Precambrian when lithologic similarities between the Noonday Dolomite, the Johnnie Formation and the Pahrump Group were noted (Dibblee, 1980).

The early miogeoclinal sequence deposited along the southern Cordilleran continental margin forms a southwest-trending, northwest-thickening sedimentary wedge. The transition from primarily cratonal sediments to miogeoclinal units is neither uniform nor laterally continuous. A general gradation exists from east to west away from the craton. Yet rock sequences in the central and southwestern Mojave are difficult to assign to either a cratonal or miogeoclinal depositional environment because in some areas they have the characteristics of both, depending upon which part of the sequence is examined. Late Precambrian terrigenous units identified in the Providence Mountains, Kelso Hills, Old Dad Mountains and Cowhole Mountains are disrupted in the southernmost areas where several unconformities are present. A complete section of terrigenous units has been identified in the Avawatz and Clark Mountains and the Kingston Range. Thus the eastern limit of Late Precambrian clastic deposition is approximately west of the central Clark and New York Mountains and west of the Kilbeck Hills and Big Maria Mountains. The southernmost extent of this boundary is as yet undefined (Burchfiel, 1981).

Paleozoic cratonal sediments have been identified in the New York, Bristol, Ship, Marble Mountains, the Kilbeck Hills, and the Big Maria Mountains.

To the northwest, in the Avawatz and Clark Mountains and in the Kingston Range, the Paleozoic cratonal section develops a miogeoclinal character, thickens, and is underlain by a fully developed group of Precambrian clastics. The western exposures in the Victorville area and the San Bernardino Mountains are structurally complex but indicate a lower Paleozoic continental slope and rise environment (Burchfiel, 1981).

In the Bristol Mountains area, the cratonal Tapeats Sandstone underlies miogeoclinal-type, mid- and upper Paleozoic rocks. The structurally attenuated Cambrian Carrara and Bird Spring Formations are nearly identical to relatively undeformed units in the Ship and Marble Mountains. The late Paleozoic strata are generally recrystallized to marble, but retain characteristics similar to the Sultan Limestone, Monte Cristo Limestone, and the Bird Spring Formation (Brown, 1981). The section in the New York Mountains is similar to the Bristol Mountains section with the inclusion of the Bright Angel Shale above the Tapeats Sandstone and the addition of the Nopah Formation between the Bonanza King Formation and Sultan limestone (Burchfiel and Davis, 1977).

In the Victorville area the upper Precambrian-lower Cambrian Wood Canyon, Zabriskie and Carrara Formations have been recognized by Stewart and Poole (1975). These units are underlain by quartzites, phyllites, and a thick upper carbonate sequence that cannot be assigned to stratigraphically similar formations to the east. The quartzite and phyllite lower portion of this series, mapped as the Oro Grande Formation, has been correlated with the Saragossa Quartzite in the San Bernardino Mountains to the west, and with clastic formations of the Providence and Nopah Mountains on the basis of comparative lithology, thickness and Scolithus(?) tubes (Dibblee, 1980). Thus, the section at Victorville includes both miogeoclinal Precambrian rocks and lower Paleozoic sediments with cratonal aspects (Burchfiel, 1981).

A relation similar to that at Victorville has been identified in the eastern San Bernardino Mountains where the terrigenous Wood Canyon, Zabriskie, and Carrara Formations are underlain by the recently recognized Big Bear Group of Cameron (1982)(Fig. 5). The Big Bear Group is an upper Precambrian shallow marine sequence, also lithologically distinct from stratigraphically correlative clastics to the east. This group includes five formations which are, in ascending order: the Wildhorse Quartzite, the Lightening Gulch Formation, the Moonridge Quartzite, the Green Spot Formation, and the Delamar Mountain Formation. The sequence is a predominantly quartzite, marble and metapelitic series indicating significant facies changes across the Mojave prior to Wood Canyon deposition (Cameron, 1982).

These data suggest that the eastern Mojave contains cratonal Paleozoic rocks, the southwestern and central Mojave contains miogeoclinal upper Precambrian sediments and cratonal early Paleozoic rocks, and only the north and northwestern region contains early Paleozoic miogeoclinal units. The early Paleozoic miogeoclinal rocks should lie north of the Cowhole Mountains near Baker and north of the Victorville area (Burchfiel, 1981).

Miogeoclinal Units

Units mapped as Paleozoic miogeoclinal sediments are, in ascending(?) order: the upper Bonanza King Formation, the Cornfield Springs Formation, the Nopah Formation which includes the Halfpint, Dunderburg Shale and Smokey members, the Sultan Limestone which includes the Crystal Pass Limestone,

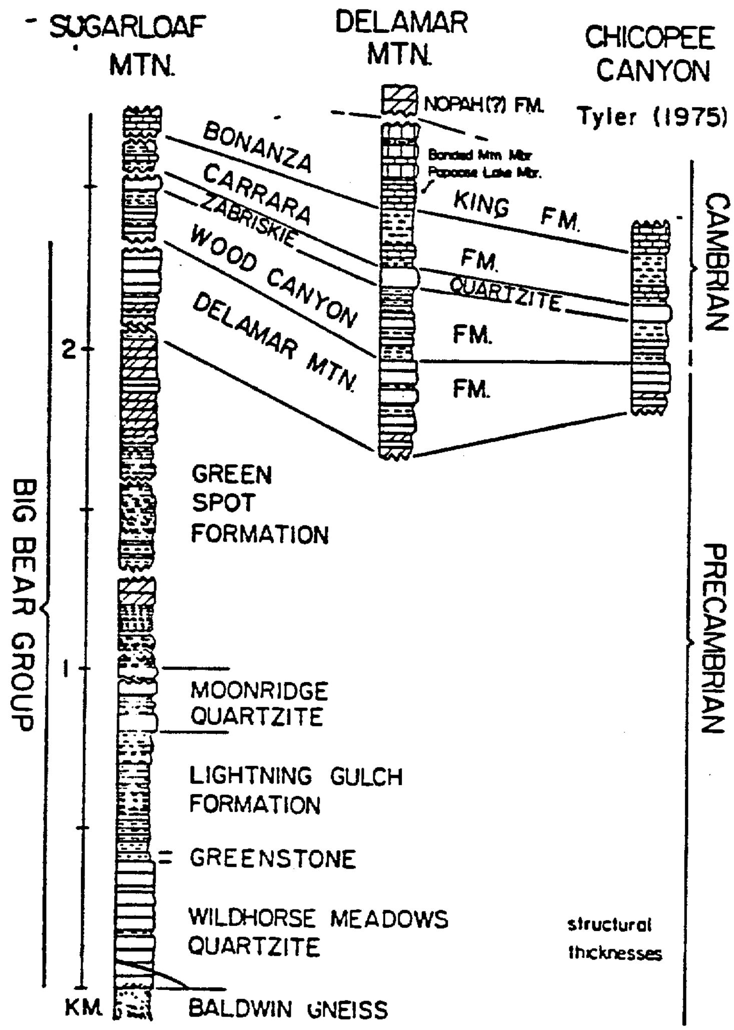


Figure 5.

Stratigraphic columns of upper Precambrian-Cambrian rocks in the Big Bear area, San Bernardino Mountains, California. Lithologic symbols are standard; thicknesses shown are structural thicknesses. (After Cameron, 1982)

Ironside Dolomite, and Valentine Limestone members, the Monte Cristo Limestone which includes the Dawn Limestone, Bullion Dolomite and Anchor Limestone members, the Bird Spring Formation, the Hodge Valley Volcanics(?) and the Kaibab Formation.

The dominantly carbonate sequence from the upper Cambrian Bonanza King through the Mississippian to Permian Bird Spring Formations are found in the northeastern Mojave Desert in the Providence, New York and Old Dad Mountains region. The Ordovician Furnace Limestone is exposed in the San Bernardino Mountains. The Hodge Valley volcanics range in age from upper Paleozoic to lower Mesozoic and are found only in the Iron Mountain/Mojave River area.

As the development of the Cordilleran geosyncline progressed, lower Paleozoic dolomites and limestones with some shales and quartzites were deposited in the Mojave region. The early sedimentation pattern remained the same, but the total depositional thickness is generally less than the early miogeoclinal units. Middle and Upper Cambrian carbonates and shales are fossiliferous, thus correlations and dating are more accurate than in the lower Cambrian strata.

In the western United States the lithofacies patterns of the middle and upper Cambrian are interpreted to be the result of an eastern shallow shelf grading westward into carbonate shoals, a deeper water open shelf, and a basinal slope. Although the position and shape of the shoal, changed continuously producing interfingering subfacies, the position of the deeper shelf and slope remained more stable. Depositional patterns were also affected by the eastward marine transgressions which developed intercalated silt and clay deposits. Several thin, laterally extensive terrigenous sand and silt deposits may be related to local nearshore uplifts or brief periods of marine fluctuations which allowed sediment to be transported farther to the west (Stewart and Suzcek, 1979).

Paleozoic miogeoclinal sediments in much of the Basin and Range north of the Mojave Desert are dominated by carbonate deposition from upper Cambrian to upper Devonian time. The continuous carbonate sequence is broken only by the laterally extensive mid-Ordovician Eureka Quartzite and minor Devonian sands. The section is typical of a Cordilleran "geosyncline" shelf-miogeoclinal sequence in which the cratonal sandstones and quartzites disappear westward concomitant with thickening of carbonates and shales (Nelson, 1981).

Miller and Cameron (1982) suggest that in the Victorville and San Bernardino Mountains region the post-Cambrian subsidence history is similar to "marginal" miogeoclinal or cratonal sections in the southern Nevada-southeastern California area. The Sidewinder Mountain Paleozoic sediments show "cratonal" affinities in that the thick sequence of Ordovican, Silurian and lower Devonian rocks is absent. Mid- to late Devonian and younger rocks rest unconformably on Cambrian strata. Other Paleozoic sections in the Victorville and San Bernardino Mountains areas are structurally disturbed but appear also to be lacking Ordovician, Silurian and lower Devonian rocks.

Known or suspected upper Paleozoic rocks in the southwest region of the Mojave are generally platform carbonate sequences and show no evidence of major clastic sedimentation during the upper Mississippian. The area must have been sufficiently distant from the Antler thrust belt that resultant debris never reached this site. The platform carbonate sedimentation apparently lasted until early Permian times (Fig. 6). This fact is suggested by correlations

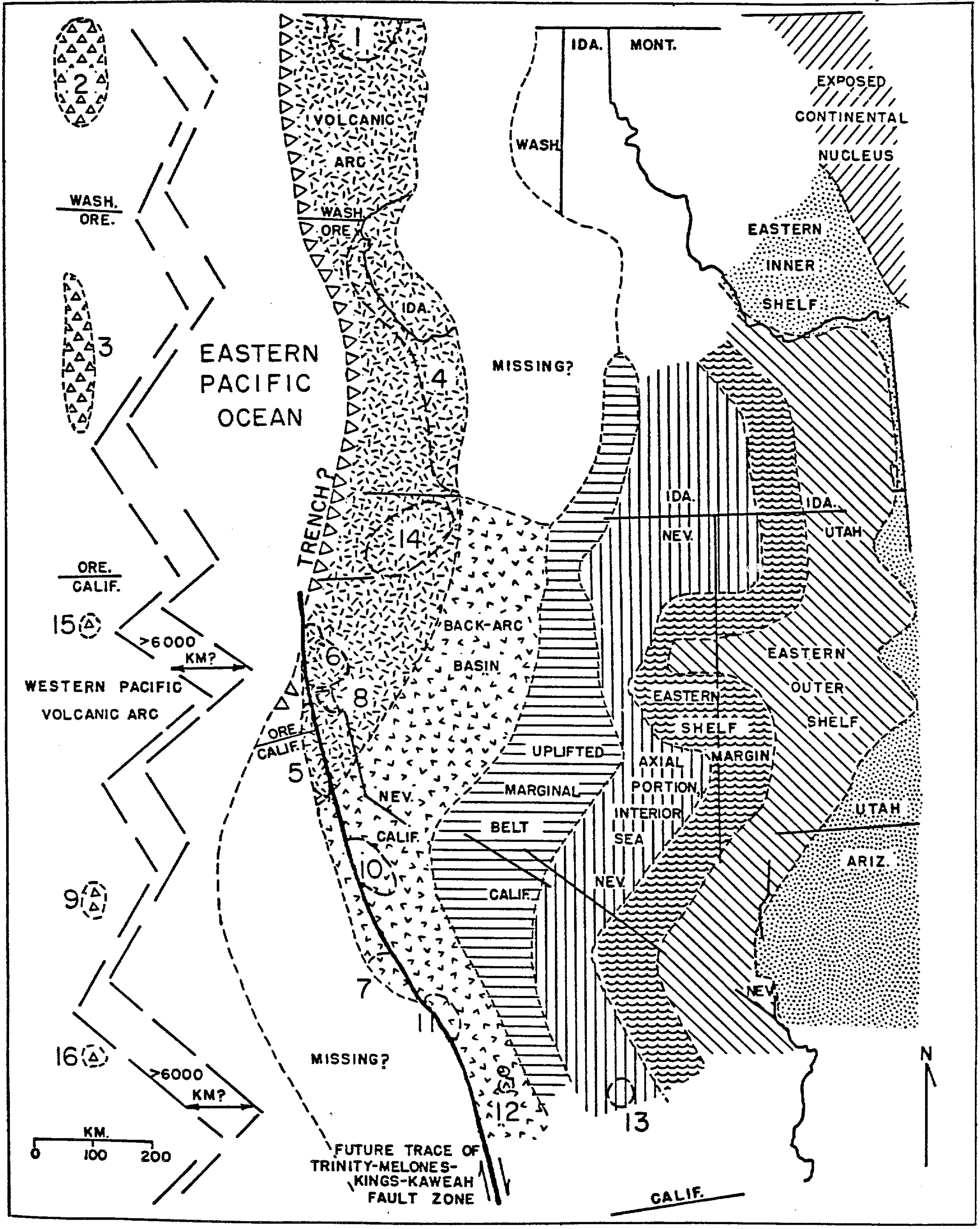


Figure 6. —Present distribution of middle Early Permian depositional provinces in the western United States. Overlapping patterns indicate areas where rocks of one province have been thrust upon those of another. (1 - northeastern Washington; 2 - Twin Lakes-San Juan Island area; 3 - central Oregon chaotic belt containing Tethyan fusulinids; 4 - volcanic rocks and Coyote Butte Limestone; 5 - Hayfork terrane, Klamath Mountains; 6 - eastern Klamath Mountains; 7 - northwestern Sierra Nevada west of Melones fault zone; 8 - northeastern Sierra Nevada; 9 - limestone pods west of Melones fault zone, central Sierra Nevada; 10 - Calaveras Formation east of Melones fault zone; 11 - "Calaveras Formation" east of Kings-Kaweah suture, southern Sierra Nevada; 12 - Carlock Formation; 13 - San Bernardino Mountains area; 14 - Happy Creek volcanics; 15 - limestone bearing Tethyan fusulinids, Klamath Mountains; 16 - limestone bearing Tethyan fusulinids, southern Sierra Nevada).

(After Stevens, 1977)

between upper Paleozoic rocks in the San Bernardino Mountains and the Pennsylvanian Bird Spring Formation and the presence of Bird Spring Formation lithology clasts in Mesozoic strata (Miller and Cameron, 1982).

In the New York Mountains, in the eastern Mojave Desert, more than 2000 m of Paleozoic and Mesozoic platform sediments are exposed. The Paleozoic units range from the Cambrian Tapeats Sandstone and the overlying Bright Angel Shale, unconformable to the Precambrian crystalline rocks, to the upper Mississippian-Pennsylvanian-Permian(?) Bird Spring Formation. An overlying calc-silicate and quartzite unit, unconformable to the Bird Spring, possibly correlates with the Triassic Moenkopi Formation (Burchfiel and Davis, 1977). Silurian and Ordovician strata have not been recognized in the area.

Correlations southwestward across the Mojave from the New York Mountains to the Providence and Cowhole Mountains and Sidewinder Mountain, indicate the Paleozoic section of the New York Mountains is laterally continuous through the area (Miller, 1981). Thicknesses vary either due to structural deformation or facies changes.

In the Palen Pass area, the Big Maria and Little Maria Montains, and the Riverside Mountains, the Paleozoic section is a metamorphosed equivalent of that found in the Grand Canyon. The most extensive but structurally disturbed exposures of this sequence are found in the Big Maria Mountains. While the rocks have been transposed and isoclinally folded, the section is generally continuous (Hamilton, 1982). Ordovician and Silurian sediments are lacking. The approximate position of the Paleozoic depositional "hingeline" runs east-west across the northeastern corner of the Mojave (Fig. 7). To the north and

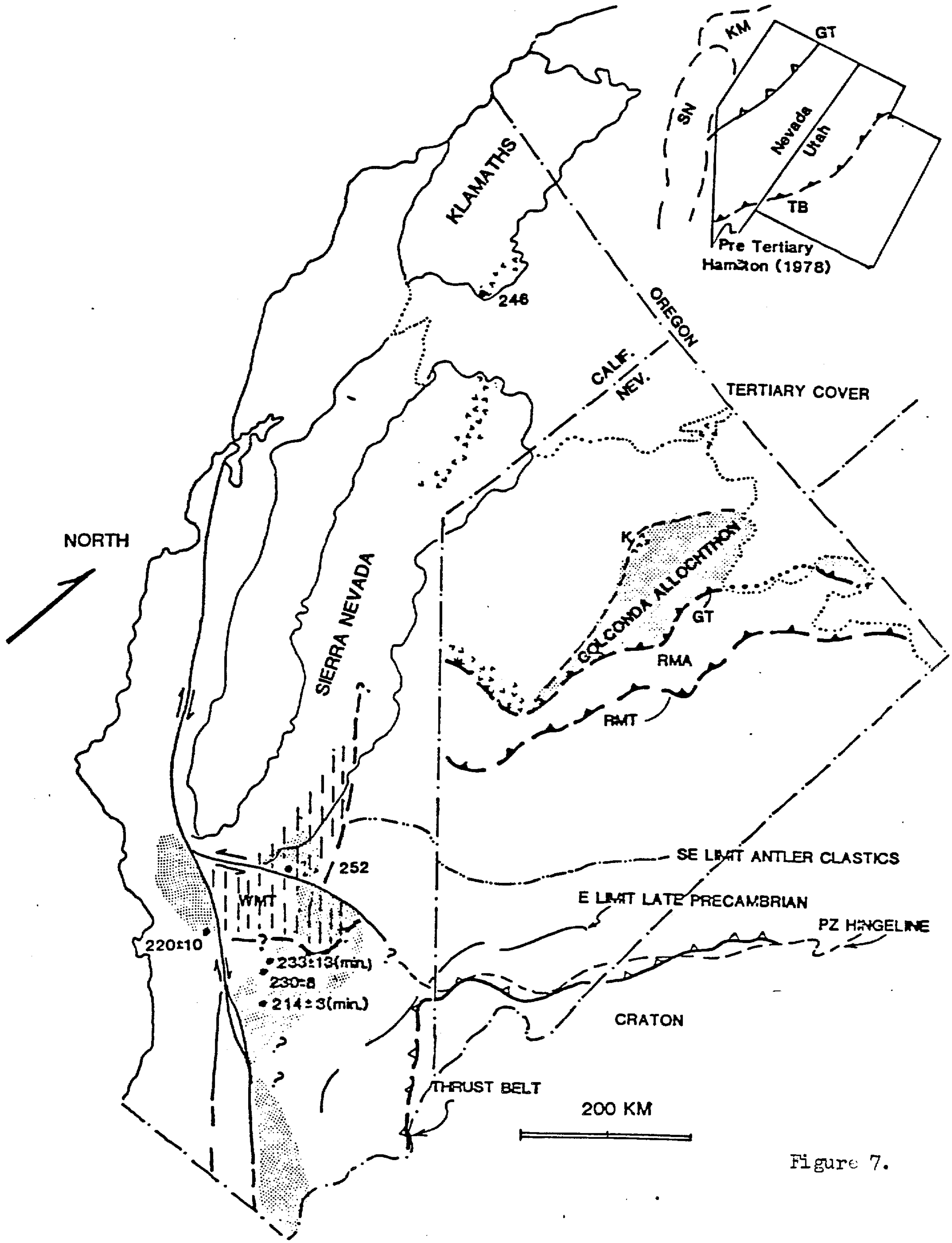


Figure 7.

California and Nevada in the Permo-Triassic
(After Miller and Cameron, 1982)

west of the line, thick sequences of rocks accumulated. The Mojave Desert region was south and east of the hingeline (Miller and Cameron, 1982).

Pse - Eugeoclinal Units

Units of the Mojave Desert that are thought to be eugeoclinal in nature are the Garlock Group, the Coyote Group and Paleozoic sequences in the Lane Mountain quadrangle and in the Shadow Mountains. The Bean Canyon Formation found in the Tehachapi Mountains and in the extreme northwest margin of the Mojave Desert, may correlate with the eugeoclinal rocks of the Garlock Series.

The Garlock Group in the El Paso Mountains north of the Garlock fault consists of greater than 10,000 m of lower and upper Paleozoic probable eugeoclinal facies rocks (Carr and others, 1981). This rock sequence contains Ordivician and Devonian fossils in the lowermost 3000 to 4000 m, which includes slate, chert, greenstone and rare limestones (Dibblee, 1967).

The Garlock Group is a structurally and stratigraphically complex sequence of deepwater marine metasedimentary and metavolcanic rocks. The rocks are of many ages spanning most of Paleozoic time. The entire group is complexly deformed in northwest-trending folds with gently plunging axes and steeply east-dipping axial planes. Poole (1974) suggested a correlation between unfossiliferous flysch-like rocks in the central part of the assemblage and Carboniferous Antler synorogenic rocks of Nevada. Two differing sequences of slope-facies or continental-rise rocks have been recognized. Interbedded chert and fine-grained siliceous clastic and metavolcanic continental rise-type rocks in the west contrast with more calcareous eastern strata interbedded with siliceous clastic rocks deposits in an upper continental-rise or slope environment (Carr and others, 1981).

The western units are comprised of chert, argillite and siltite, pillowed greenstone, chert-pebble conglomerate, quartzite and sandy and silty carbonate rocks (Poole and Christiansen, 1980). Many of the argillite and siltite units are possibly fine-grained turbidites.

The eastern units are complexly folded and faulted with repeated sections common. The units consist of thinly interbedded limestone, siltstone and chert plus other units of bedded chert, limestone and silty limestone, quartzite, slate, and local greenstone. A distinctive interlayered quartzite and black-slate sequence contains Ordovician graptolites (Carr and others, 1981).

Units tentatively correlated to the Garlock Group in the Goldstone area, the Lane Mountain area, and the Shadow Mountains area consist of metasediments whose protoliths were impure sandstones, cherts, siltstones, shales and limestones. In the Pilot Knob Valley rocks similar to the Garlock Group contain Devonian conodonts in a distinctive sandy limestone unit identical to one of the lower units identified by Dibblee (Carr and others, 1981).

Paleozoic rocks in the Goldstone area correlate in part, to the rocks containing Ordivician fossils in the eastern part of the Garlock assemblage. The age of some Goldstone assemblage look-alikes, the Coyote Group, exposed in the Lane Mountain quadrangle is uncertain although a possible Pennsylvanian brachiopod was found in the southern part of the mountains. If these rocks are in part Paleozoic, they do not resemble pure Paleozoic carbonate sequences southeast of Victorville nor are they like the miogeoclinal units to the northeast.

The Bean Canyon Formation, a possible correlative of the Garlock Group, is comprised of marbles, dark schists, metaargillite, minor amounts of quartzite and metabasalt. The rocks are nonfossiliferous and of doubtful age. In this northwestern area of the Mojave a mylonitic and mylonitic(?) schist, possibly a segment of the Bean Canyon Formation, has also been suggested as a correlative to the Pelona Schist (Dibblee, 1980). Not enough information is available at this time to determine the exact nature of the unit.

Two recent explanations have been suggested for the location of these eugeoclinal rocks. Poole and others (1977) indicate the Garlock Group lies within the Roberts Mountain allochthon. Burchfiel and Davis (1972), Poole (1974) suggest the allochthon consists of sedimentary and volcanic rocks displaced eastward across the Devonian-Mississippian continental margin. The overlying clastic units may represent flysch deposits from the Antler allochthon (Poole, 1974). Poole and his co-authors suggest a continuity of the Antler and Sonoma orogenic belts northward from the western Mojave Desert to west-central Nevada. They attribute the irregularity of the Antler belt to dextral oroclinal bending of Mesozoic and Cenozoic age. Dickinson (1977) attributes this irregular trend to an initial pattern of rifts and transform faults along the western North American craton in late Precambrian time.

Burchfiel and Davis (1981) suggest an alternative explanation for the "out-of-place" eugeoclinal Paleozoic rocks. They indicate that all facies and isopach lines for the miogeocline trend to the southwest or west. There is no suggestion of these lines turning southward parallel to a different continental margin. The eugeoclinal rocks are possibly not just a simple continuation southward of the early and late Paleozoic thrust-faulted rocks in west-central

Nevada. In their present position just north of the "cratonal" rocks of the Victorville area, the eugeoclinal rocks would require thrust faulting across the entire miogeocline. Burchfiel and Davis (1981) further point out that the upper Paleozoics near Victorville and in the San Bernardino Mountains contain no terrigenous component which would be expected if the Antler or Sonoma highlands had occupied the Mojave locations suggested by Poole and Sandberg (1977). They are in agreement with Poole (1974) in that the lower Garlock Group is probably part of the Antler orogenic belt overlain by upper Paleozoic clastics.

Burchfiel and Davis (1981) speculate that the eugeoclinal rocks of the El Paso Mountains were moved southward as part of a major fault sliver or slivers from correlative west-central Nevada and northeastern California rock sequences. Attendant faulting is suggested by Davis and others (1978) to be an expression of the Permo-Triassic left-slip faulting of part of the North American continental margin. The eastern bounding fault of this major sliver is thought to trend southward between the Argus and the El Paso Mountains, and be displaced eastward along the Garlock fault; it then curves westward north of the San Bernardino Mountains (Burchfiel and Davis, 1981).

The question as addressed by Miller and Cameron (1982) of a pre-Permo-Triassic-deformation "truncation" or pre-Mojave block "salient" may remain unsolved. Mesozoic and Cenozoic subduction and strike-slip tectonism have modified and removed parts of the margin. Yet stratigraphic studies indicate many of the following paleogeographic elements present along the Cordilleran margin to the north are missing in the Mojave region:

1. A full fledged subsiding miogeocline.

2. An Antler-age foredeep basin.

3. An Antler-age thrust belt together with whatever lay outboard of the belt.

4. Marginal basin sequences such as those of the Golconda allochton.

5. Remains of the coeval forearc and subduction complex, despite evidence for arc plutonism in the Permo-Triassic.

PMs Paleozoic/Mesozoic sedimentary rocks, undifferentiated.

Most of the Paleozoic/Mesozoic rocks in the Mojave Desert have, at least tentatively, been assigned to various stratigraphically or lithologically correlative formations. Yet within the western and northwestern region and the Peter Kane Mountains several sedimentary units cannot easily be assigned to either Paleozoic or Mesozoic sequences. Not enough information is available to map the exact nature of the following units.

El Centro 2° Sheet

PMs mapped at the far southeast margin of the Peter Kane Mountains near the Imperial Dam are in contact with Tertiary volcanics and a portion of a Precambrian metamorphic and igneous complex. Strand (1962) mapped these as pre-Cretaceous metamorphic rocks.

Salton Sea 2° Sheet

PMs mapped in the eastern Pinto Mountains within(?) the Joshua Tree National Monument are surrounded by Jurassic and Cretaceous age intrusions. Precambrian and Mesozoic metamorphic rocks are mapped to the southwest and southeast, respectively.

San Bernardino 2° Sheet

PMs mapped on the west side of Cucamonga Peak in the eastern San Gabriel Mountains is in contact with Pelona schist to the north and is separated from mylonitic Pelona schist to the south by Cretaceous intrusions. Rogers (1967) mapped this area as pre-Cretaceous metamorphic or metasedimentary rocks.

Trona 2° Sheet

PMs mapped on the north side of Lane Mountain is in contact with Paleozoic eugeoclinal(?) rocks to the north and a Cretaceous intrusion to the south. This sequence is probably Paleozoic but not necessarily associated with the eugeoclinal(?) rocks. Aztec Sandstone equivalent units to the east suggest the possibility that these PMs rocks are Mesozoic.

PMs mapped on the south of the Soda Mountains and in the Cowhole Mountains are in fault contact with a Cretaceous intrusion. The presence of Paleozoic units to the north suggests a Paleozoic association. Correlations by Novitsky-Evans (1978) indicating the presence of Mesozoic Aztec Sandstone equivalents in the Cowhole Mountains suggests more strongly these PMs units are part of the Aztec Sandstone unit.

PMs-mapped within the Garlock fault zones east of the Quail Mountains is in fault contact with Tertiary volcanics. Precambrian and Mesozoic metamorphics are mapped to the east in the Avawatz Mountains and to the west in the Slate Range. Considering the eastward movement along the Garlock, these PMs units may be correlative to the Mesozoic metamorphics in the Slate Range.

Mesozoic

Ms Mesozoic sedimentary rocks, undifferentiated.

Burchfiel and Davis (1981) state that Mesozoic rocks of the Mojave region are represented generally by plutonic and volcanic rocks developed as part of an evolving and shifting magmatic arc of continental margin (Andean) type. The full extent of Mesozoic sedimentary rocks within the Mojave region is not yet known, but they are clearly subordinate to coeval igneous rocks.

The only unit mapped as an undivided Mesozoic sedimentary sequence is the Soda Mountains Formation found in the northern Soda Mountains. Although other Mesozoic proto-sediment sequences exist in the Mojave Desert they are generally mapped as Mesozoic metasediments or are overlain by later Mesozoic or Tertiary rocks. The upper Triassic(?)-Jurassic(?) Aztec Sandstone is included in units mapped as Mm but will be discussed within this section due to its relatively unmetamorphosed state.

Triassic Moenkopi and Chinle Formations have been identified in the extreme eastern region of the Mojave Desert. The Moenkopi Formation has been recognized in the Providence Mountains, but has not been mapped separately for this project.

A lower Triassic unnamed limestone and interbedded red and green argillite sequence is overlain by the Soda Mountain Formation in the northern Soda Mountains. The Soda Mountains Formation is comprised of andesitic breccias and non-marine sandstones and is approximately 7,000 feet (2,150 m) thick. Grose (1959) suggested that this unit is correlative with the upper Triassic-Jurassic(?) Aztec Sandstone.

The Aztec Sandstone or its equivalents(?) has been correlated westward from the Mescal Range to the Old Dad Mountains, the Cowhole Mountains, the

Soda Mountains, Cave Mountain, the Rodman Mountains, the Victorville area (Marzolf, 1980), and the Big Maria Mountains region (Hamilton, 1982).

The unit is the youngest Mesozoic stratigraphic unit which has been followed westward into the developing early Mesozoic orogen (Marzolf, 1980). The unit rests on fluviatile redbeds in the Mescal Mountains, yet westward the Aztec sand was blown over a surface of deformed Paleozoic carbonates resulting from eastward-directed thrust sheets (Marzolf, 1980). Marzolf (1980) suggests that the shallow-marine rock sequence in the Soda Mountains may represent sediments deposited in an intra-arc basin.

In Utah and Nevada, the Navajo and Aztec sandstones, as discussed by Marzolf (1982) interfinger southwestward with those of the Moenave and Kayenta Formations. In the eastern Mojave Desert, Aztec sandstone and its equivalents interfinger with intermediate to silicic volcanics (Fig. 8). The unit rests unconformably on deformed Paleozoics or strata assigned to the Triassic Moenkopi Formation. Marzolf further suggests stratigraphic relationships which indicate pre- and post-Moenkopi tectonic events. This is indicated by the discordant relationship between the Moenkopi Formation of the western Soda Mountains and underlying Paleozoic rocks coupled with the absence of Moenkopi strata due to erosion in the eastern Soda and Cowhole Mountains (Fig. 9).

The Aztec sandstone identified in the Cowhole Mountains rests discordantly on Paleozoic carbonates or early Mesozoic volcanics. The unit consists of a basal conglomeratic segment containing Bird Spring Limestone clasts. Volcanic flows are interbedded with cross-bedded sandstone sequences. The entire sequence is overlain by the andesitic to quartz latitic Delfonte Volcanics. A volcanoclastic unit exposed at the base of a similar rock sequence in the

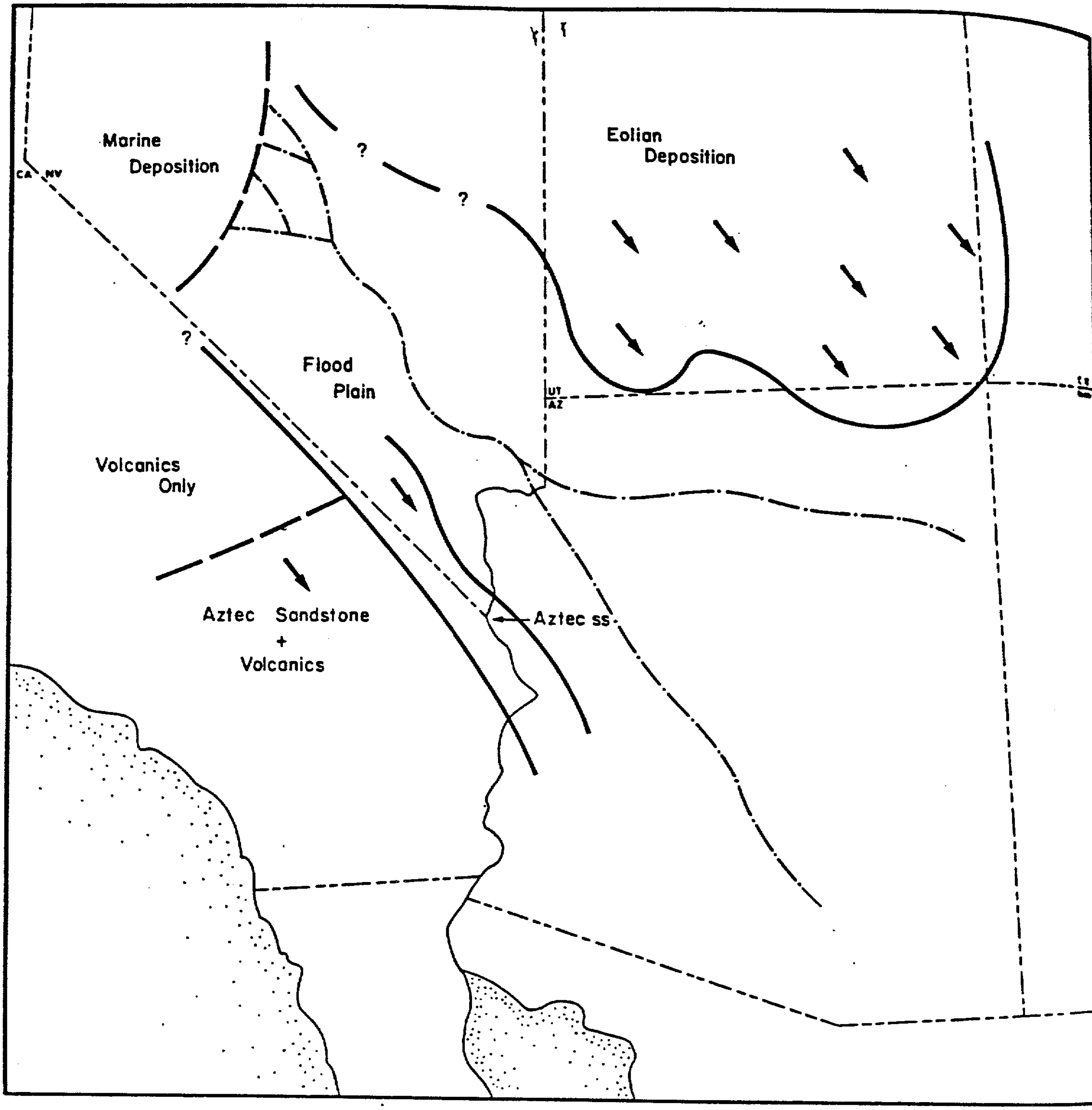


Figure 8. Paleogeographic map illustrating relationships of eolian, fluviatile and, eolian and volcanic facies during Rhaetian to Sinemurian time. Littoral zone has not been preserved. (After Marzolf, 1982).

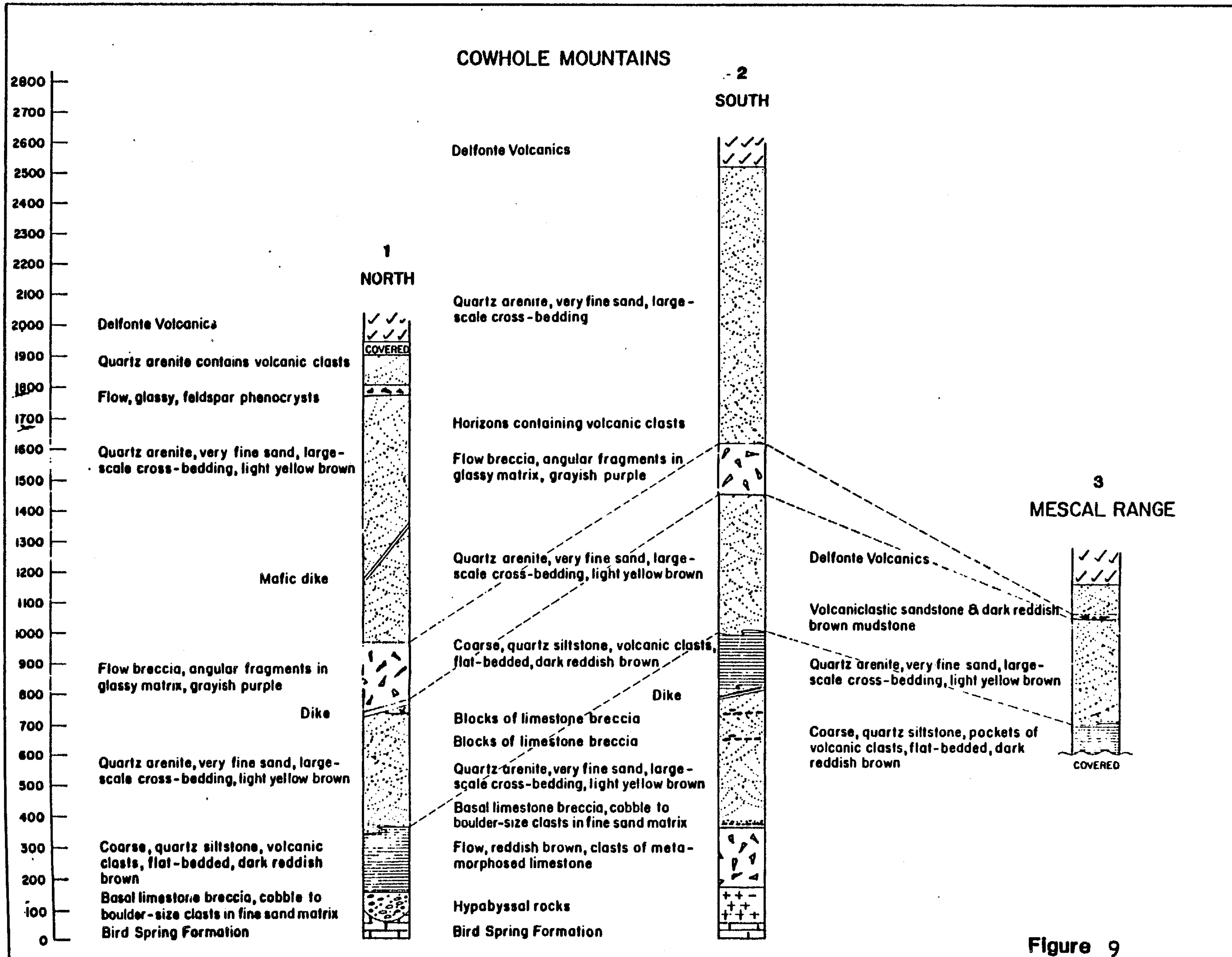


Figure 9

(After Marzolf (1980))

Mescal Mountains is tentatively correlated with lower sections measured in the Cowhole Mountains. Marzolf (1980) suggests this correlation implies a substantial thickness of Aztec sandstone in the Mescal Range had been eroded prior to deposition of the Delfonte Volcanics.

The Jurassic(?) Delfonte Volcanics conformably overlie the Aztec Sandstone and its equivalents in the northeast Mojave Desert. This unit has been described in the Cowhole Mountains (Miller and Cameron, 1982) and the Old Dad Mountains (Dunne, 1977).

At Old Dad Mountain, Dunne (1977) indicates approximately 300 feet of Aztec sandstone unconformably overlying Paleozoic Bird Spring Formation carbonates. A single volcanic flow in the upper exposed section observed by Marzolf is truncated by the Playground thrust fault.

Miller and Carr (1978) describe a sequence of pure orthoquartzites and volcanogenic sediments in the Rodman Mountains which is similar to Aztec-equivalents in the Soda Mountains-Cowhole Mountains area. The overlying calc-silicate and limestones are unique to the Rodman Mountains in that no similar rocks are known to overlie the Aztec-equivalents of the eastern Mojave. The presence of Mesozoic sedimentary rocks within the region of the magmatic arc suggests that at certain times or, in certain areas, the arc may not have been topographically high but a non-marine or shallow marine environment.

Hamilton (1982) tentatively correlates a ferruginous quartzite underlying Middle Jurassic ignimbrites in the Big Maria Mountains to the Aztec Sandstone of the eastern Mojave. This unit is fine-grained and ferruginous enough to commonly weather red where metamorphosed at low-grade. Volcanoclastics have not yet been identified in this unit.

JKs Pelona, Rand and Orocopia Schists

Outcrops of Pelona, Rand and/or Orocopia schist (Pelona-Orocopia) are mapped in the Peter Kane and Chocolate Mountains, the Orocopia Mountains, the San Gabriel, the southern Tehatchapi, and Rand Mountains. Ehlig (1981) quotes Pelka
Gabriel, the southern Tehatchapi, and Rand Mountains. Ehlig (1981) quotes Pelka
(1973a) in suggesting that the McCoy Mountain Formation in the McCoy and Palen Mountains may be a relatively unmetamorphosed facies of the Pelona-Orocopia protolith. This tentative correlation is considered highly unlikely, however, because of siginificantly different lithological characteristics (Rehrig, 1983, personal communication) and ages.

Haxel and Dillon (1978) describe the Pelona-Orocopia schist as a body of rocks showing a Cretaceous/Paleocene metamorphic age of lower-greenschist- to lower-amphibolite- facies. A chief property of schist is its uniform textural and outcrop character. Dark, biotite-rich, foliate rock without noticeable compositional banding is diagnostic over large areas. The protolith is predominantly graywacke with lesser amounts of pelite, basanite(?), ferromanganiferous chert, marble, and mafic to ultramafic rock. Rarely, thin (<5') magnesium carbonate beds occur in the sequence. In the Rand Mountains disseminated sulfides and reports of fuchsite (green, chrome-bearing mica) (Troxel and Morton, 1962) disclose to these writers the probability of subaqueous exalite horizons.

These deep marine or oceanic sediments are techtonically overlain along the Vincent-Orocopia thrust by allochthonous Precambrian to Mesozoic gneissic to granitic rocks. In several areas, the metamorphic grade and grain size within the schist increases upward to the thrust exhibiting an inverted metamorphic zonation. Thus, the thrust itself is not a metamorphic discontinuity, yet there is still the steep metamorphic gradient within the thrust zone. Lineations at the base of the upperplate parallel lineations within the schist in a generally north-northeast and south-southwest direction. These relationships indicate that metamorphism took place beneath the upper plate of the Vincent-Chocolate Mountain thrust and was generally coeval with movement along the thrust (Fig. 10). The inferred direction of overthrusting is north to northeast (Haxel and Dillon, 1978).

While the upperplate of the Vincent thrust contains Mesozoic plutonic rocks as young as 80 ± 10 m.y. cut by the thrust, plutons (two-mica granite sills) have not been dated in the lowerplate schist (Ehlig, 1981). Movement on the thrust possibly took place between 50 and 60 m.y. ago based on ages obtained from thrust zone mylonites and from lowerplate metamorphic rocks (Ehlig, 1981).

The Pelona (Orocopia) schist exhibits a minimum thickness of about 3500 m as exposed in the eastern San Gabriel Mountains. Nearly 90% of the protolith consists of well-bedded graywacke, siltstone and claystone metamorphosed to a gray-colored white mica-albite-quartz schist, a grayschist. The lower part of the section contains well-preserved sedimentary structures including graded bedding, which suggest distal turbidite fan or basin plain deposition. Greenschist derived from basaltic tuff and 1%-2% quartzite makes up the remaining 10%+ of the Pelona schist in the San Gabriel Mountains. The greenschist, mainly in the upper third of the formation, is generally thin bedded with metachert and marble lamellae. The metachert is commonly laminated and rich in manganese and iron. Bennet and De Paelo (1982), using Nd isotopes, have determined a possible 850 m.y. age for the Pelona (Orocopia) schist protolith. If this age is correct it will significantly alter previous opinions of the units as Mesozoic in age.

Haxel and Dillon (1978) indicate that the palinspastic map of the Pelona-Orocopia schist and Vincent-Chocolate Mountains thrust shows that the schist lies generally along and beneath the eastern margin of the Sierra Nevada-Salina-Peninsular Ranges' Cretaceous batholithic belt. Therefore, this unit occupies a very different tectonic position than the lithologically similar Franciscan complex and the lithologically dissimilar Great Valley sequence that occur extensively on the west side of the batholithic belt. The Franciscan complex includes the Catalina schist which is similar in composition to the Pelona-Orocopia schist, but older in metamorphic age. The inferred direction of overthrusting along the Vincent-Chocolate Mountain thrust (northeast) is roughly opposite to that along the Coast Range thrust overlying the Franciscan Complex.

Haxel and Dillon (1978) further indicate that all of the schist bodies of the lower plate were, prior to offset along the San Andreas and Garlock fault systems, connected at depth beneath a regional allochthon. The bulk of the schist is still deeply buried beneath the Mojave Desert. The present exposures of the schist are due to uplift and deep erosion.

The allochthonous upperplate rocks may not have counterparts east of the San Andreas fault. The possibility exists that the allochthon comprises at least one exotic microcontinent and that the Pelona-Orocopia protolith may also be exotic. This protolith may have been deposited elsewhere and then tectonically introduced sometime after the truncation of the continental margin in late Permian or early Triassic time.

Ehlig (1981) agrees, for the most part, with the Haxel and Dillon model of emplacement. He goes on to suggest that if an errant microplate is indeed the protolith of the schist, its basement terrane should differ in tectonic history and composition from in-place North American basement terrane. The two differing terranes should be marked by a boundary. A change in basement rocks is apparent across the San Francisco-Fenner fault and along the western Clemens Well fault. Isotopic studies indicate differences in basement between the San Gabriel-Orocopia Mountains and the San Bernardino Mountains. The model further requires the leading edge of the thrust to occur east of the most easterly exposures. The McCoy Mountain Formation has been suggested as a relatively unmetamorphosed part of the nose of the thrust (Ehlig, 1981).

Alternatively, Burchfiel and Davis (1981) advocate a westward overthrusting of the Pelona-Orocopia schist. They suggest that the shallow underthrusting beneath a crust warmed by magmatic activity (granitic rocks of the Cretaceous magmatic are cut by the thrust) may have added to the inverted metamorphism seen in the underlying schist. The Franciscan rocks provide protolith sediments from the early Cretaceous to the early Triassic, whereas the ensiamatic basin proposed by Haxel and Dillon would required diachronous development. Physical evidence for the supposed opening and closing of the basin is lacking. They further suggest that the northeastward underthrusting of the schist, as documented by Haxel and Dillon, and Ehlig, might represent antithetic faulting above an active, deeper zone of underthrusting. The presence of the geographically separate Rand schist in the northwestern Mojave is explained as part of an earlier underthrusting event.

While the McCoy Mountains Formation is not a documented correlative to the Pelona-Orocopia schist, the unit will be discussed in this section, due to the controversy surrounding the unit. Ehlig (1981) suggested the possibility that this unit may be part of the slightly metamorphosed leading edge of the Vincent-Chocolate Mountains thrust. Pelka (1973a, b) also has suggested that a southwestward-dipping thrust underlain by the McCoy Mountains Formation may correlate with the Vincent-Chocolate Mountains thrust and that the McCoy Mountains Formation itself may be a near-shore facies of the Pelona-Orocopia schist protolith.

Paleomagnetic data for the McCoy Mountains Formation indicates a metamorphic event during or earlier than upper Middle Jurassic and thus the protolith is older (Harding, 1982). The McCoy Mountains Formation is further described by Harding (1982) as a siliciclastic unit deposited in a narrow west-northwest trending basin; the unit physically separates North American cratonal rocks from rocks of the Mojave-Sonoran complex, a composite terrane that includes the San Gabriel, Joshua Tree, and Orocopia schists and the Vincent thrust. A recently determined paleomagnetic age date plus the stratigraphic position of the McCoy Mountains Formation does not support the suggestions that this unit is part of the eastern edge of the Pelona-Orocopia thrust system.

<u>Mm/Km</u> - Mesozoic and Cretaceous metamorphics

In the eastern Mojave Desert, Mesozoic terrigenous sediments were deformed by a northwest trending, shifting magmatic arc terrane associated with convergent plate boundary activity along the Permo-Triassic continental margin. Present knowledge of Mesozoic depositional environments is derived from studies of roof pendants in Mesozoic granitic rocks containing metamorphosed Mesozoic sediments, volcanic and igneous rocks.

The Aztec Sandstone and its equivalents have not been considered in this designation due to their relatively unmetamorphosed state. The McCoy Mountains and Palen Mountains Formations might have more accurately been included as Ms (Mesozoic sediments) due to their slight degree of metamorphism.

Units included and mapped as Mesozoic metamorphics are:

Triassic and Triassic(?) Sidewinder Metavolcanics found in the Victorville and Barstow areas.

Ord Mountain Group found to the east and south of the Victorville and Barstow areas and considered correlative to the Sidewinder Metavolcanics by Dibblee (1967).

Fairview Valley Formation found in the Black Mountain-Sidewinder Mountain area.

McCoy Mountains Formation found in the McCoy Mountains in the south-eastern Mojave.

Palen Mountains Formation found in the Palen Mountains.

As discussed by Burchfiel and Davis (1981), the eastern edge of the magmatic arc fluctuated with time yet the entire Mojave lay within the Mesozoic arc at one time or another. Establishing exact time/space relationships is difficult. Published age dates are generally K-Ar which probably represent partial cooling or uplift ages and partial or complete resetting of older rock ages. Also the stratigraphic position of Mesozoic volcanic rocks is incompletely known.

Several areas within the magmatic arc contain metasedimentary rocks with uncertain origins. These rocks suggest the arc terraine was at times both a marine and a nonmarine sediment depositional site (Burchfiel and Davis, 1981). In the Victorville area the Fairview Valley Formation, a sequence of shallow marine and alluvial fan sandstones, limestones and conglomerates, unconformably overlies deformed Paleozoic rocks. This sequence was intruded by monzonites at least 233± m.y. age (Miller and Sutter, 1981). The Triassic Sidewinder Metavolcanics, unconformable above the Fairview Valley Formation in the Victorville Formation, is a section of mildly to intensely metamorphosed dacite flows, pyroclastic rocks, metatuffs, and schistose metavolcanic units. This unit may be lithologically correlative to the Aztec Sandstone in the Rodman Mountains region (Miller and Cameron, 1982)(Fig. 10).

The Triassic(?) Ord Mountain Group, a sequence of basaltic flows, tuff, breccia and porphyritic intrusive rocks, has been suggested as at least coeval with the Sidewinder Metavolcanics. The metavolcanics are all intruded by granitic rocks of possible or known Late Jurassic age (Miller and Morton, 1981). Miller and Cameron, 1982, point out that the Fairview Valley Formation is apparently older than sequences which include the Early Jurassic Aztec Sandstone which suggests that it is possibly Triassic in age, and may be coeval with the Moenkopi Formation and its eastern Mojave equivalents. These sequences post-date Permo-Triassic miogeoclinal rock deformation in the Soda Mountains and at Cave Montains.

Pendants in the Tehachapi Mountains, north of the Garlock fault, contain a schist, quartzite, limestone, argillite and metavolcanic sequence. Rb-Sr studies of the metavolcanics indicate an upper Jurassic age (Burchfiel and Davis, 1981). A similarity between the stratigraphic sequence of these units and those of the Sierra Nevada pendants has been noted.

In the southwestern Mojave region the Mesozoic metavolcanic and volcanogenic metasedimentary rocks may be Jurassic or earlier in age as they pre-date Late Jurassic plutons (Miller and Cameron, 1982). Younger metamorphic rocks

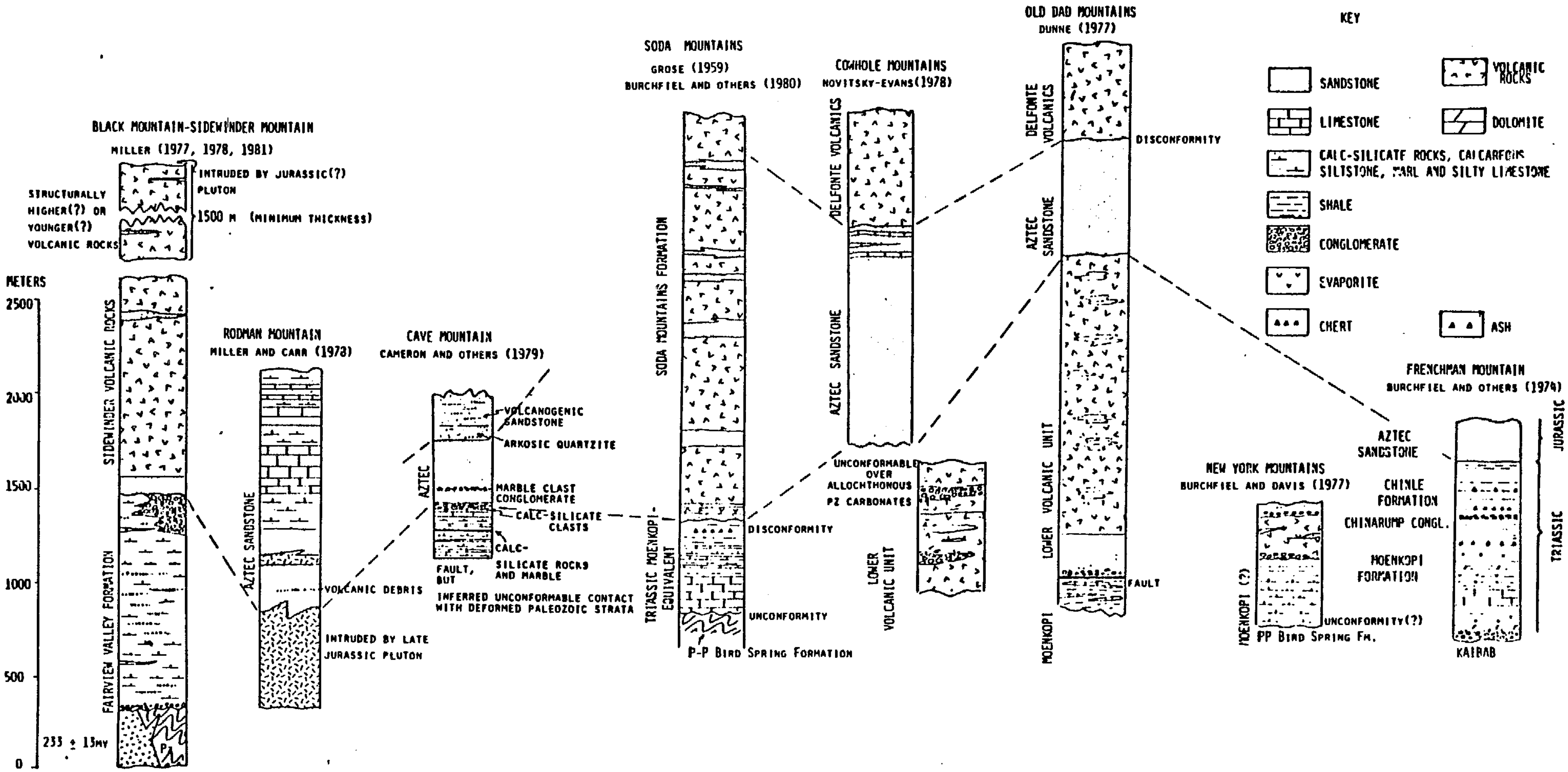


Figure 10. Correlation of Mesozoic sedimentary rocks across the Mojave Desert (After Miller and Cameron, 1982).

are not positively known. These Mesozoic metasediments are in contact with Jurassic plutons and only slightly deformed. Low-angle normal faulting observed in the rock units is thought to be extensional tectonism of roof rocks associated with Late Jurassic pluton emplacement in the San Bernardino Mountains.

The Vitrifax Formation as defined by Dillon (1976) in the Cargo Muchacho Mountains consists of a muscovite-quartz schist that is transitional into the quartzofeldspathic gneiss of the Precambrian Tumco Formation.

Mi, Ki, Ji, Tri - Mesozoic intrusions: Triassic, Jurassic, Cretaceous.

Units included and mapped in this designation are:

Atolia Quartz Monzonite (Ki) foiund in the Atolia-Randsburg area.

Cactus Quartz Monzonite (Ji-Ki?) found at Cactus Flat in the northern San Bernardino Mountains.

Mount Lowe Granodiorite(Tri?) found in San Gabriel Mountains.

Palms Quartz Monzonite (Ji-Ki?) found in the south-central and southeast Mojave Desert borderland.

Sands Granite (Ji?) found in the east-central Mojave Desert near the Cowhole Mountains.

Teutonia Quartz Monzonite (Ki?) found in the Cima Dome area in the east-central Mojave Desert.

Victorville Quartz Monzonite (Ki) found in the Victorville region.

White Tank Quartz Monzonite (Ji) found in the south-central Mojave Desert.

The oldest associated plutonic rocks within the magmatic arc are of intermediate composition and are found in the western Mojave Desert. An alkalic monzonite pluton in the Granite Mountains has been dated at 230 ± 10 m.y. (Miller, 1977a, b) while a similar pluton in the Victorville area has yielded a ^{40}Ar- ^{39}Ar fusion age on a hornblende of 233 $\pm$ 14 m.y. (Miller, 1977). The Mount Lowe Granodiorite, dated by Silver (1971) at 220 $\pm$ 10 m.y., is similar in composition and texture to rocks as far southeast as the Chocolate Mountains (Dillon, 1976).

As discussed by Burchfiel and Davis, 1981, during the Middle and Late Triassic the magmatic arc shifted eastward to the Soda Mountains and Old Dad Mountain area (Burchfiel and Davis, 1981). Renewed Middle Jurassic magmatic activity, after an Early Jurassic pause, resulted in emplacement of rocks to the west of the earlier Late Triassic magmatic rocks. The eastern limit of Upper Jurassic rocks is east of all other arc-related rocks. Rocks to the southwest may be associated with this event. Early to early Late Cretaceous arc activity limits were near to the Upper Jurassic arc rocks and may be part of the same arc. Latest Cretaceous (Laramide) plutons are rare north of the Garlock fault but are found scattered throughout the southern Mojave region.

The Teutonia batholith, in the Cima Dome area, is one of the larger intrusive complexes in the eastern Mojave Desert. The batholith is comprised of Jurassic to Cretaceous metaluminous to weakly peraluminous, granitic plutons which generally post-date thrusting in the area. Emplacement also post-dated the Mesozoic and younger metamorphic, and mylonitization, events seen in many of the nearby mountain ranges (Calzia, 1982); therefore, the Jurassic isotopic ages may be erroneous.

The batholith consists of six main phases: the Black Canyon hornblende gabbro, the Live Oak Canyon granodiorite, the Mid Hills adamellite, the Ivanpah granite, the Rock Spring monzodiorite and undifferentiated granitic rocks of the batholith (Beckerman, et al, 1982). K-Ar age dates for the batholith range from 57.9 $\pm$ 4.3 to 168.4 $\pm$ 11.8 m.y. (Beckerman, et al, 1982).

In the Little Maria Mountains two plutons, the Late Cretaceous Midlands and the Early Tertiary Little Maria, have been identified. The Midlands pluton consists of granitoids and shows a well-developed tectonic foliation and ranges in texture from augen gneiss to schist. The Little Maria plutons are highly leucocratic intrusions exhibiting marked absence of tectonic foliation, indicating post-deformational igneous activity (Emerson, 1982).

Emplacement of Mesozoic plutons of granodiorite, granite and diorite in the Turtle Mountains has been dated at between 72.0 and 167.0 m.y. (Howard and Marvin, 1982). Biotite-muscovite monzogranite dikes have been recognized peripheral to the main Turtle pluton, but have not been mapped for this report for lack of accurate locational information.

In the western Riverside Mountains, relatively unfoliated Mesozoic granite and quartz monzonite is common (Carr and Dickey, 1980). Quartz monzonite tectonites are found locally between thrust sheets (Lyle, 1982).

The Mesozoic plutonic rocks of the Old Woman-Piute Range include Late Cretaceous granodiorites and two-mica granites. These units are both cut by thrusts and are generally unaffected by metamorphism and deformation. The two-mica granites appear younger when viewed in contact with the granodiorites. The two-mica granites are subdivided into five plutons with the informal names of Painted Rock, Sweetwater Wash, Lazy Daisy, East Piute, and North Piute (Miller, et al., 1982). Miller and others (1982) indicate that the granodiorites are probably younger than 98 m.y. and the two-mica granites are between 70.5 and 79.7 m.y.

Granitic plutons intruded the Argus and Slate Ranges in Middle Triassic time. Most of the plutons are calc-alkalic and most are thought to be associated with the Sierra Nevada batholith. Some Early Jurassic intrusives are alkalic and were possibly derived from a magma of unusual composition (Dunne, et al, 1978).

TKi - Laramide Intrusions, 75-50 m.y.B.P.

Laramide-age intrusions include two-mica granites mapped in the Cadiz Valley area, possibly as part of the final intrusive stage of the Cadiz Valley batholith, and those in the Chemehuevi and Arica Mountains. The Cadiz Valley batholith intrudes Jurassic age plutonic rocks. Much of the Cadiz Valley batholith including the two-mica granitic plutons, shows a partly mylonitic gneiss interpreted as due to flattening of the roof above the batholith during emplacement (Howard and others, 1982). Of the three intrusive phases of the batholith, the oldest is a biotite-sphene granodiorite and the youngest, by field relationships, a two-mica monzogranite. Outcrops of this monzogranite in the Iron Mountains contain accessory muscovite which appears to be both primary and secondary in origin.

Fine- to medium-grained, garnet-muscovite aplite and pegmatite dikes are found along the edges of the batholith. In the Coxcomb Mountains these dikes have a well-developed northeast-trending mylonitic lineation (John, 1981).

The Coxcomb Granodiorite possibly associated with the Cadiz Valley batholith is exposed over 155 sq km in the Coxcomb Mountains. This complex intrudes the McCoy Mountains Formation and includes pendants of rocks mapped as the Jurassic quartz monzonite. The granodiorite is subdivided into four intrusive facies, one of which is a biotite-muscovite monzogranite.

K-Ar ages from the Coxcomb Granodiorite range from 65.1 ± 2.0 to 70.8 ± 1.0 m.y. (Calzia, 1982). These ages may not be indicative of emplacement ages because the monzogranite yields ages of 54.9 to 68.8 m.y. on biotite and muscovite for the same sample. Discordant K-Ar ages west of the Coxcomb Mountains may be due to Late Cretaceous to early Tertiary thermal disturbance (Miller and Morton, 1980). Calzia (1982) notes that recent age data suggests this disturbance may extend into the Coxcomb Mountains.

The autochthon of the Chemehuevi Mountains metamorphic core complex consists of a Laramide(?) calc-alkaline metaluminous to peraluminous plutonic suite (Johns, 1982). The suite exhibits a crude type of concentric zonation of younging rocks toward the center. The youngest and most leucocratic phases are a muscovite-bearing and locally garnetiferous granite and granodiorite that form the center of the pluton.

In the Arica Mountains a Cretaceous foliated granodiorite intrudes the gneissic basement. Zircon dating has established an age of emplacement of 63.0 m.y. (Baltz, 1982).

Tv - Tertiary volcanic rocks - undivided:

Although Tertiary volcanic rocks are widespread throughout most of the Mojave region, their ages, composition and source vents are poorly known. Consequently, some volcanic rocks within the study area have had to remain undivided. Most of these undivided rocks occur in the Bristol and Bullion Mountain Ranges in the eastern part of the San Bernardino and western part of the Needles AMS sheets. Glazner (1981) has described a general stratigraphy in this part of the central Mojave consisting of a basal arkose overlain by intermediate flows and tuffs. This lower volcanic unit is locally thick, but not widely exposed. Overlying these andesites is a much more areally extensive bimodal sequence of high titanium basalts and silicic tuffs that appear to be of post-subduction age and signal a change from compression to extension in the regional stress field. The upper major unit consists of biotite-hornblende-dacite flows and domes. Sparse age dates suggest that the volcanism in this region was initiated about 23 m.y. ago and ended by about 19 m.y. ago (Glazner, 1981).

Many of the rocks marked Tv in and around the Stedman district are silicic in composition (i.e., rhyodacites to rhyolites).

Ti - Tertiary plutonic and hypabyssal rocks - undivided:

Most of the rocks marked Ti on Plate 1 are subvolcanic to volcanic in character. Fine-grained holocrystalline rocks do occur, however, in the central and southern Chocolate Mountains and in the southeastern part of the San Gabriel Mountains. These rocks are largely leucocratic granodiorite to granite in composition and range in age from 23 to 14 m.y.B.P. (Miller and Morton, 1977).

We have made an attempt to label the Tertiary intrusions on Plate 1 with a subscript denoting composition. Thus, Ti's with a subscript "r" are rhyolitic (rhyodacite to rhyolite) in composition; those with a subscript "a" are andesitic to possibly dacitic in composition; and those denoted with a subscript "b" are basaltic in composition. Dikes are generally unlabeled.

In general, the plutonic and hypabyssal rocks are of the same age and comagmatic with the volcanic rocks with which they are spatially associated. Thus, intrusions in the Chocolate Mountains, Black Hills and Paleo Verde Mountains probably range in age from about 35 to 19 m.y.B.P. (i.e. Crowe and others, 1979). The oldest Tertiary igneous rocks in the Mojave are thought to occur in this area. Intrusive plugs and domes in the Turtle and Mopah ranges west of the

Whipples probably represent volcanism that erupted between 25 to about 20 m.y. ago. In the northern portion of Plate 1, local clusters of rhyolitic intrusions tend to predominate. Few age dates exist for these rocks and they are largely unpublished. Indications are that this rhyolitic ativity began about 18 m.y.B.P. and continued to about 11 m.y. ago. These rocks are important for they are believed to be post-subduction and are associated with much of the gold mineralization in this region. Locally, such as near Barstow and Rand, late-Miocene to Pliocene andesitic plugs intrude shallow continental sediments and coeval volcanic rocks.

The distribution of these Tertiary plutonic and hypabyssal rocks is displayed on Overlay 8 with relationship to other Tertiary tectonic features. While most of the dikes depicted on this overlay are believed to be Tertiary in age, some could be as old as Mesozoic.

Miocene age plutonic rocks that intrude the Pelona and Orocopia schists are found on opposite sides of the San Andreas fault 235 km apart. Plutonic rocks intruding Pelona schist in the San Gabriel Mountains are biotitic granodiorite and yield K-Ar ages of 18.6 to 14.0 m.y. (Miller and Morton, 1977). Plutonic rocks intrusive into the Orocopia schist in the Chocolate Mountains are hornblende-biotite quartz monzonite and yield K-Ar dates of 20.0 to 23.4 m.y. (Miller and Morton, 1977). The differences in age coupled with different textures, mineral compositions, modal compositions and content of Al_2O_3, and total iron suggest the two plutonic groups are either unrelated or only very generally related.

Ts - Tertiary sediments - undivided:

The units labeled Ts on Plate 1 are largely of continental character. Locally included within this designation are fanglomerates, volcaniclastic and pyroclastic rocks and interbedded volcanic flows.

Basin development and sedimentation across much of the western and central Mojave appear to have formed shortly after the close of subduction related volcanism in late Oligocene to early Miocene time. These sediments accumulated in several large valley(?) type structures that formed as depositional basins (Dibblee, 1980). By about 18 m.y. ago much of the northern part of the study area began to experience deformation that may have been related to the now regionally developed Basin and Range Province (Dokka, 1980). In the central Mojave, this resulted in the development of east-west-trending sags and domes that created the regionally expansive Barstow basin. Other large basins (see Overlay 3) had also developed by this time in the western and northern portions of the study area. Rhyolitic volcanism erupted through many of these basins and provided large amounts of pyroclastic and volcaniclastic debris to the sedimentary section. Significant epithermal mineralization is associated with these rhyolites in the Loraine, Mojave, Rand, and Hart districts. Water in the lacustrine basins into which these rhyolites intruded probably provided the fluids for development of the large hydrothermal cells evident in these areas. Intrusive andesitic rocks into the Barstow basin produced widespread silver mineralization in the Tertiary sediments in the Calico area.

In later Tertiary time (Clarendon and Hempillian age), terrestrial sedimentary and local volcanic formations developed in basins near or along the San Andreas and Garlock fault zones (Dibblee, 1980). Since sediments of this age are largely missing in the western and central basins of the Mojave, it is thought that subsidence of those basins ceased after Miocene time, when the new basins were forming along the margins of the Mojave Desert region.

We have attempted to outline the probable extent of Tertiary sedimentary basins on Overlay 3. The extent of these basins is important because it implies that sufficient water was probably available in these areas to supply circulating geothermal systems to any related intrusive activity. While large cells obviously did not form in every case, it nonetheless provides us with ballpark areas in which to explore in.

Tof & Tom - Older Tertiary felsic and mafic (to intermediate) volcanic rocks.

Cenozoic volcanism began in the study region about 35-30 m.y. ago in response to widespread melting of the lower crust perhaps instigated by sinking of the flattened Laramide subduction plate. The major pulse in this calc-alkaline or "orogenic" volcanism occurred in the region between about 26 and 18 m.y.B.P. (cf. Crowe and others, 1979; Glazner, 1981; Dokka, 1980; and, Lukk, 1982). Most of this age of volcanic activity was concentrated in the eastern, southern, and central portions of the study area. While no actual calderas have been yet mapped in these areas, volcanic relationships suggest that major centers of this volcanic activity existed in the southern Chocolate Mountains, Palo Verde Hills, Mopah and Turtle ranges, Clipper Mountains, Broadwell Mesa area north of Ludlow, Bristol Hills, and in the Bullion Mountains.

On Plate 1 we have attempted to subdivide this older period of volcanic activity into two general categories: Tom and Tof. Unit Tom consists of rocks of basaltic to intermediate composition (i.e. basalts, andesites, dacites).

Unit Tof is composed of essentially silicic volcanic rocks of rhyodacite to rhyolite in composition, including domes, flows, breccias, tuffs, and pyroclastic material.

Tyf-Tym - Younger Tertiary felsic and mafic (to intermediate) volcanic rocks:

Volcanic and tectonic styles throughout nearly the entire western United States went through a profound change during the mid-Miocene. Collision of the Pacific Plate with the North American Plate and the subsequent development of the San Andreas transform system progressively stopped subduction along the western edge of southern California. By about 18 m.y. ago compressional tectonics associated with subduction had been converted into fundamentally deep crustal extension associated with Basin and Range type block faulting across much of the western United States. At this same time a major change in volcanism was recorded over this same area, shifting from a largely subduction related "orogenic" style to a fundamentally basaltic or bimodal basalt-rhyolite assemblage. The Mojave region is complicated because both styles of volcanism overlap in places. Basaltic and rhyolitic volcanism began in the study region about 19 to 18 m.y.B.P. The age of inception varies slightly for different regions. It began in the western Mojave portion about 19 m.y.B.P. and extended to at least 12 m.y. ago (Wilson, unpubl. data); at 19 m.y.B.P. in the adjoining parts of west-central Arizona (Suneson and Luchitta, 1978a & b); between 18 and 11 m.y. B.P. in the Lanfair basin area (McCurry, 1980); about 18 m.y.B.P. in the central Mojave (Hillhouse and others, unpubl. M.S.); and about 18-15 m.y.B.P. in the Vidal-Parker region (Carr, 1981). The late Tertiary rocks were mainly erupted from local volcanic centers widely scattered across the study area. Major centers of rhyolitic activity existed near Loraine, in the Mojave-Rosamond area, near Randsburg, at the Opal Mountain-Fremont Peak areas, in the Lanfair basin (Castle, Hackberry and Woods Mountains), in the Northern Providence Mountains, and possibly in the Bullion Mountains. All of this rhyolitic activity appears to have ceased within the study area by about 11 m.y. ago.

Since late-Miocene, the only apparent volcanic activity within the study area consists of scattered alkali-olivine basalts and local patches of andesitic to dacitic rocks in the Barstow area and in the Lava Mountains northeast of Randsburg.

On Plate 1 we have subdivided this younger period of volcanic activity (<18 m.y.B.P.) into two general categories: Tym and Tyf. Unit Tym consists of rocks of basaltic and intermediate (andesite to dacite) composition. Unit Tof is composed of essentially silicic volcanic rocks of rhyodacite to rhyolite in composition, including domes, flows, breccias, tuffs and pyroclastic rocks.

METALLIZATION

The discussion presented in this section is based largely on a regional analysis of the Precious Metals Overlay 4 combined with the lithotectonic map (Plate 1). Silver districts with little or no gold, such as Calico, are not dealt with. An Other Metals Overlay 5 is also provided. Since gold and silver are often associated with an assortment of other metals on a district-wide scale, this overlay was used in the general overall metallic distribution for the project area. In the event that client wishes to evaluate the region for other metal commodities in the future, this Other Metals Overlay 5 should provide the needed basic data.

It is appropriate at this time to briefly discuss the data base that was used for the Metals Overlays 4 and 5. We used the data base prepared for the Bureau of Land Management's study of the California Desert Conservation Area (CDCA). This study was conducted in 1980 and collated data from 150 sources (see references of CDCA Metal Occurrences appended to this study). We compared and added to this base from the U.S. Geological Survey's updated CRIB occurrence data for precious metals in southern California. The composite of these data results in the Precious Metals Overlay 4. While there are undoubtably some occurrences that have been missed in the study area, we feel this compilation composite is as comprehensive as possible with the current state of knowledge in the Mojave area.

The main purpose of the subsequent overview part of the metallization section is two-fold: (1) to determine whether there are any correlations between precious metals and particular lithostratigraphic units, and (2) to delineate any regional structural or tectonic controls on mineralization.

As it turns out, this type of analysis is very difficult in the Mojave region due to incomplete geologic mapping in many of its mountain ranges and the wide separation of these areas by vast expanses of alluvial material. Therefore, unlike the Northwest study, there are few, if any, linear belts or alignments of metal occurrences which can be delineated.

Overview and Regional Distribution

Areas of Precious Metals Depletion

Gold occurrences are widely scattered throughout the Mojave region and few lithostratigraphic units are actually devoid of such occurrences if considered across the entire project area. The "barren" areas are listed as follows:

a. Metamorphic core complexes:

A disassociation between metals and areas of high-grade metamorphic and granitic rocks of the metamorphic core complexes was noted by Rehrig in northeastern Washington (Rehrig, 1983; consulting report). The same generalization appears to hold for the Mojave study area as well. With few exceptions, the highly metamorphosed rocks of the cores of these complexes within the Mojave are devoid of precious metal occurrences.

b. Pliocene-Pliestocene basalts:

Areas of Pliocene-Pleistocene basalts, as one would expect, are essentially devoid of any base or precious metals. This results in several fairly broad blank areas on metals overlays over central and northern portions of the project area.

c. Laramide plutons (Tki):

Interestingly, Laramide age plutons exposed in the study area (mainly within the Needles sheet) show a paucity of gold occurrences. This is probably not a genetic characteristic of these rocks because gold occurrences are found around their margins in places. Many of the sulfide-rich mesothermal veins found in older Mesozoic granitic rocks in nearby areas may actually be related to the Laramide plutons. For example, sericite selvages on gold veins in the Cargo Muchacho district produce Laramide ages (Newmont, unpubl. data). Still, the cores of large intrusive bodies constitutes poor prospecting ground.

d. Northwest-striking wrench faults:

The Lenwood, Camp Rock and Helendale faults (Overlay 3) are part of a family of right-slip wrench faults that traverse the western and central portions of the Mojave Desert. These faults are typically high-angle, right lateral faults consisting of anastomosing and single strand segments (Dokka, 1980). The faults consist of short, en echelon segments with regions between segments experiencing extension or shortening depending on whether the strand is right- or left-stepping, respectively (Dokka, 1980). Most of the present-day topography of the area formed in response to these faults. They appear to have had no fundamental control or influence on any mineralization within the region in which they occur. Since movement along these faults is considered to be post-Barstow Formation (<13 m.y.; cf. Dokka, 1980), it serves to help place a lower limit on the age of mineralization in the area affected by these faults. In addition, these faults might provide some clues in searching for such things as Calico type settings in rocks believed to have suffered up to 10-15 km of separation along individual strands.

e. Garlock and San Andreas fault zones:

While in rare cases mineralization occurs in relatively close proximity to these major strike-slip fault zones, they do not appear to have exerted any genetic influence on the localization of mineral deposits along them.

Areas and Trends of Precious Metals Concentration

From this scale of regional prospective, lithostratigraphic units (other than the relatively barren ones described above) appear to display rather widespread and scattered mineralization. Some obvious trends and areas of metal concentration, however, do exist. While some appear to be associated with specific intrusive activity or lithstratigraphic units, others appear to suggest structural controls. The units and areas of precious metals concentration are identified below in only brief and general terms. These are described in more detail under the District Focus and Metallization Summary sections that follow.

a. Vincent-Chocolate Mountains allochthon:

One of the most striking concentrations of precious metals within the region of study occurs along areas where the Vincent-Chocolate Mountains thrust crops out. In proximity to the fault, mineralization can occur in both the lowerplate schists and upperplate crystalline rocks. The upperplate rocks, however, are considered in this report to possess a great deal of potential for hosting undiscovered major-size gold deposits, while the potential in the lowerplate is probably much less. Major gold deposits and mines such as Goldfield's new Mesquite discovery, Picacho and possibly the Yellow Aster are hosted in structurally prepared zones in upperplate rocks of the thrust. Much more will be said about this regional tectonic zone in later sections of this report.

b. Other thrust faults:

Other thrust fault zones appear to have exerted control in influencing metal concentrations in a manner similar to that exhibited by the Vincent-Chocolate Mountains allochthon. Highly significant past gold production and considerable new reserves exist along the American Girl-American Boy fault zone in the Cargo Muchacho Mountains. This fault consists of a low-dipping sheeted zone that is believed to be a thrust fault.

Much of the low-grade gold mineralization in the northern part of the San Bernardino Mountains occurs in highly broken Paleozoic marbles along a late(?) Cenozoic low-angle reverse or thrust zone that crops out along the range front. Rumors are circulating that huge tonnages of low-grade gold mineralization have been established at the old Black Hawk mine along this zone.

Likewise, thrust faulting associated with the Sevier orogeny (i.e., Clark Mountains thrust complex, Old Woman-Piute Mountains thrust zones, etc.) also has locally influenced concentrations of metals. A small thrust of unknown age exposed in the Bullion Mountains south of Amboy Craters, also displays significant gold mineralization (American Mine).

A complex zone of thrusting and normal faulting exposed in the Big Maria and Little Maria Mountains north of Blythe and related to closure of the Jurassic McCoy basin and its suturing unto the North American craton, also seem to influence the concentration of metals in these ranges.

c. <u>Late Miocene silicic volcanic activity</u>:

Mid- to late-Tertiary volcanic rocks are widely scattered across the Mojave project area. Volumetrically, considerable portions of these rocks are mafic to intermediate in composition (Tom and Tym on Plate 1). About 18 to 19 m.y. ago and probably extending to about 10 m.y., the central, northern and western Mojave began to experience a style of deformation that may have been related to the now regionally extensive Basin and Range Province (i.e., Dokka, 1980). Throughout much of this region continental sedimentation and contemporaneous volcanic rocks were accumulating in numerous basins. By about 17 m.y.B.P. (Dokka, 1980), east-west-trending sags and adjoining highlands had developed sufficient relief so that major sedimentation had accumulated in some of the basins. Widely scattered rhyolitic volcanic centers intruded these sediments and/or produced interbedded flows and tuffs. These silicic rocks are believed to be of the alkali-feldspar rhyolite kindred (i.e., Wilson, 1983) and result from small partial melts of the lower crust rising into the upper crust during an extensional tectonic regime. Gold mineralization appears to be spatially and genetically related to these rocks in a number of areas; the Mojave-Rosamond, Rand, Loraine, Stedman, Hart and Hackberry districts are considered to be examples. In contrast, silver-rich mineralization hosted by Tertiary sediments and volcanics in this region (i.e., Calico and Lava Beds districts) are thought to be related to andesitic volcanic activity.

In the central part of the Mojave, some workers (i.e., Glazner, 1981; Polovina, 1980; and references contained therein) suggest that the localization of this volcanism, sedimentation and associated mineralization has been controlled by a lineament or feature that has become referred to as the Barstow-Bristol Trough (see Overlay 3). While this does appear as a present physiographic feature, its influence, if any, on Tertiary volcanic activity and associated mineralization is difficult to ascertain.

d. Paleozoic eugeosynclinal sediments:

An assemblage of complexly deformed and metamorphosed eugeosynclinal rocks (Garlock Assemblage) exposed in the El Paso Mountains north of Randsburg and in the Goldstone and Lane Mountains north of Barstow display numerous metal occurrences. Most of the mineralization is superficial, discontinuous and usually hosted in narrow fractures and shear zones cutting these rocks. Mineralization is probably related to Mesozoic plutons which intrude these sediments. The Garlock Assemblage is in part correlative with rocks of the Antler allochthon in Nevada. As such it may have some potential for hosting Carlin-type mineralization if the proper setting can be found within the Mojave.

A somewhat more carbonate-rich group of rocks also thought to correlate with the Garlock Assemblage crops out in the southern and eastern edge of the Shadow Mountains northwest of Victorville. While no gold occurrences are shown to exist in these rocks, NURE HSSR geochem anomalies do appear in streams draining them.

e. <u>Precambrian metamorphic terrain:</u>

In certain portions of the study region, particularly in the eastern half, Precambrian gneisses are common hosts to precious metals occurrences. Mineralization within these rocks is typically along shear or fracture zones; usually in areas that have been strongly intruded by Mesozoic or Tertiary igneous rocks. Districts such as Hexie, Lost Horse, Chuckwalla, Providence North, and Vanderbilt are examples of gold districts found in this type of setting.

In many thrust related terrains, Precambrian gneissic rocks in the upperplate appear to be excellent host rocks for mineralization. These rocks tend to fracture in brittle fashion rather than form gouge-filled shear zones and this probably favors them for subsequent mineralization. Areas along the Vincent-Chocolate Mountains thrust and the Sevier thrusts serve as examples.

f. <u>Mesozoic intrusive terrain:</u>

Quartz dioritic to quartz monzonitic intrusive rocks of Jurassic to Cretaceous age underlie the vast majority of the Mojave project area. While large areas of these rocks are relatively devoid of metallization, many of the districts in the Mojave are hosted by veins that cut these rocks. Some, and probably most, of these veins are certainly of a much younger age than the intrusive rocks which they cut. In some cases, however, mesothermal type mineralization exists in veins and extends outward into older gneissic or metasedimentary host rocks that are often thermally affected (hornfels or skarn) adjacent to the intrusions. Gold-bearing deposits of this type are typically sulfide-rich and in contact zone settings often contain associated tungsten mineralization. Some of the deposits in the Baldwin Lake, Eagle Mountains and possibly Gold Park, Holcomb Valley and Dale districts may represent this deeper style of mineralization

g. On a regional scale, metals, chiefly of copper, gold, iron and manganese, appear to concentrate around the margins of metamorphic core complexes. Nowhere is this distribution more strikingly shown than in the Whipple Mtns. west of Parker Dam. The other example is the Sacramento-Chemehuevi area to the northwest of the Whipples. The metals concentrate in the brecciated, fragmented and propylitically altered rocks which surround mylonitic, metamorphic cores of the complexes.

District Focus

This section deals with specific mining districts and areas from which gold has been produced or where interesting clusters of occurrences exist.

It provides brief descriptive summaries of these areas in terms of location, geology and gold mineralization, mines of interest, and pertinent references. Mention is made of exploration concepts deserving attention in some of the areas. Because of past production, favorable structure, alteration or lithostratigraphic criteria, individual mines have been noted in many of the districts. They deserve reconnaissance examination during any future regional exploration. Certain districts or permissive terrains within districts, are highlighted in a later section of this report. Favorable districts are identified on Overlay 7.

Metallization Summary

From examining the preceeding district descriptions, it is apparent that gold mineralization within the Mojave project is spatially widespread with certain types of deposits being repetitiously present. Common genetic classes of deposits that frequently occur in the region include mesothermal vein and contact deposits (i.e., Dale, Chuckwalla, Eagle Mountains, Gold Park, Baldwin Lake, Holcomb Valley, Oro Grande and numerous other districts), epithermal fissure vein (Mojave, Rand, Loraine and Gold Reef districts), hotspring deposits (Hart, Hackberry and possibly Rand, Mojave and other districts), eugeosynclinal sediment-hosted deposits (El Paso Mountains and Goldstone districts), breccia hosted deposits (Clark Mountain and Stedman districts), and mineralized thrust structures (Black Hawk, Cargo Muchacho, Chocolate Mountains, Picacho, Clark Mountain, Mount Baldy and other districts).

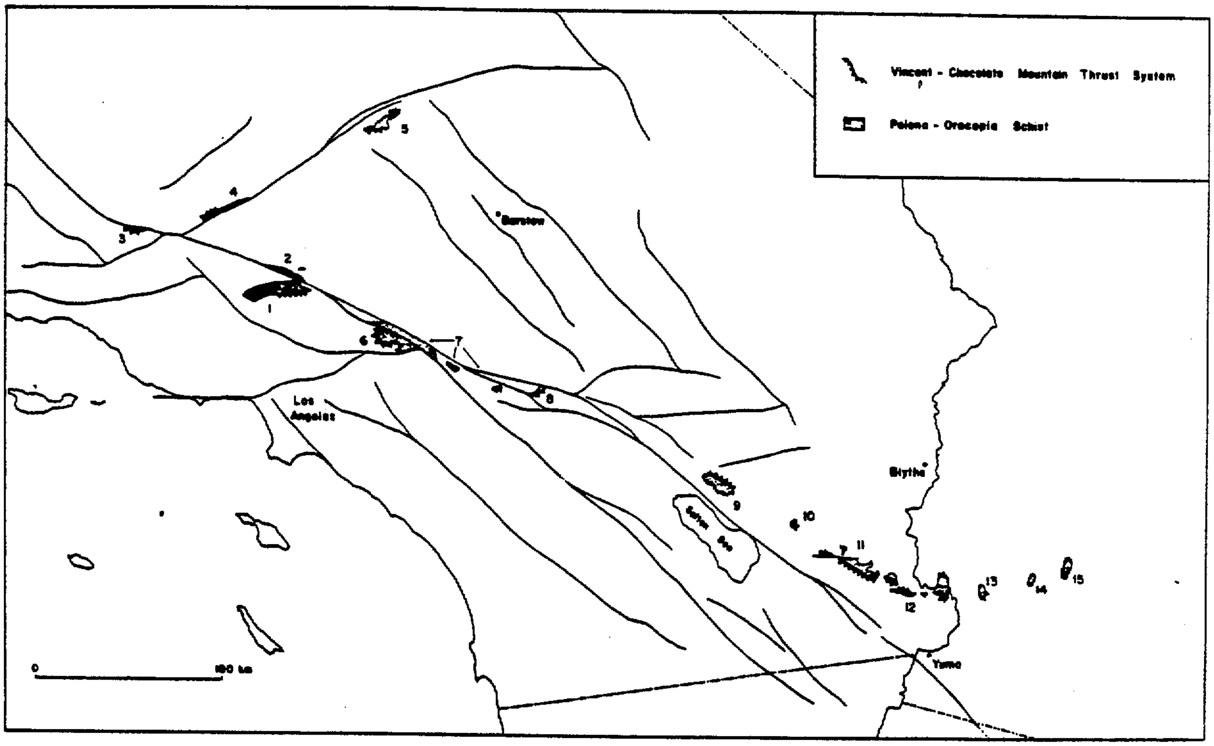
Interesting mines and mineralization occur in each of these settings due to such things as quirks of structure (i.e. mesothermal or epithermal vein systems may have permeated and mineralized a wide shear or breccia zone) or unusually receptive host rocks which have been replaced by zones of gold-bearing mineralization. In cases such as these, the mines have been noted within the descriptions of the districts in which they occur. We feel that many of these warrant actual "follow up" ground examination. Outside of these fortuitous types of examples however, most of the vein and mesothermal contact deposits probably offer little potential for hosting 1 million ounce orebodies.

There exists, however, several distinct environments that repeatedly occur within the region that exhibit an unusual "geologic permissiveness" suitable for hosting major (approximately 1 million ounces) bulk tonnage gold deposits. In certain cases, obvious target areas exist within several of these prospective terrains. We strongly urge, however, that a method of systematic exploration be taken in examining these broad, favorable areas in order to fully take advantage of the exploration models and concepts presented herein.

Permissive Terrains and Geologic Models

1. Vincent-Chocolate Mountains Allochthon Model:

The Pelona, Rand, Orocopia and Chocolate Mountains schists are names applied to groupings of at least 15 distinct areas (Fig. 14) of schist exposed in southwesternmost Arizona and along the San Andreas and Garlock faults in southeastern California. These schists are predominantly metagraywacke containing subordinate metapelite, metabasite, metachert, marble and ultramafic rock (Haxel and Dillon, 1978). Although outcrops of the schists are presently spread over a considerable area, they are generally believed connected at depth in a regional autochthon (below the Vincent-Chocolate Mtn. thrust), before being offset along the San Andreas and Garlock fault systems. The schist is tectonically overlain along the Vincent-Chocolate Mountains thrust by nappes of Precambrian through Mesozoic granitic and gneissic rocks. Near the thrust, these upperplate rocks are intensely broken and cataclastized (Fig. 15). Below the fault the schist displays metamorphic coarsening of mineral grain size and zones of mylonitization. The entire appearance of this zone is broadly similar to that displayed by the detachment faults associated with the mid-Tertiary metamorphic core complexes.



Number	Location	Name of schist
1	Sierra Pelona(*)	Pelona
2	Portal and Ritter Ridges, Quartz Hill	Pelona
3	Mount Pinos, Mount Abel	Pelona
4	Tehachapi Mountains	Pelona
5	Rand Mountains(*)	Rand
6	Eastern San Gabriel Mountains (southwest of San Jacinto fault)	Pelona
7	Blue Ridge to Crafton Hills (between San Jacinto and San Andreas faults)	Pelona
8	North side of San Gorgonio Pass	Pelona
9	Orocopia Mountains(*), Mecca Hills	Orocopia
10	Central Chocolate Mountains	Orocopia
11	Southern Chocolate Mountains	Orocopia
12	Picacho-Peter Kane Mountain area, California; Trigo Mountains, Arizona	Orocopia
13	Middle Mountains, Arizona	Orocopia
14	Castle Dome Mountains, Arizona	Orocopia
15	Neversweat Ridge, Arizona	Orocopia

Figure 14 Distribution of the Pelona-Orocopia schist and Vincent-Chocolate Mountain thrust system (after Jennings, 1973; Ehlig, 1968; Dillon, 1976; Haxel, 1977) and Cenozoic strike-slip faults (after Jennings, 1973; Crowell, 1975a) in southern California and southwesternmost Arizona. Schist bodies are numbered as in Table 1; schist bodies 1 to 9 are the same as shown by Ehlig (1968, fig. 1). Some of the smaller schist bodies are shown slightly exaggerated in size and the geometry of most of the thrust faults is simplified.

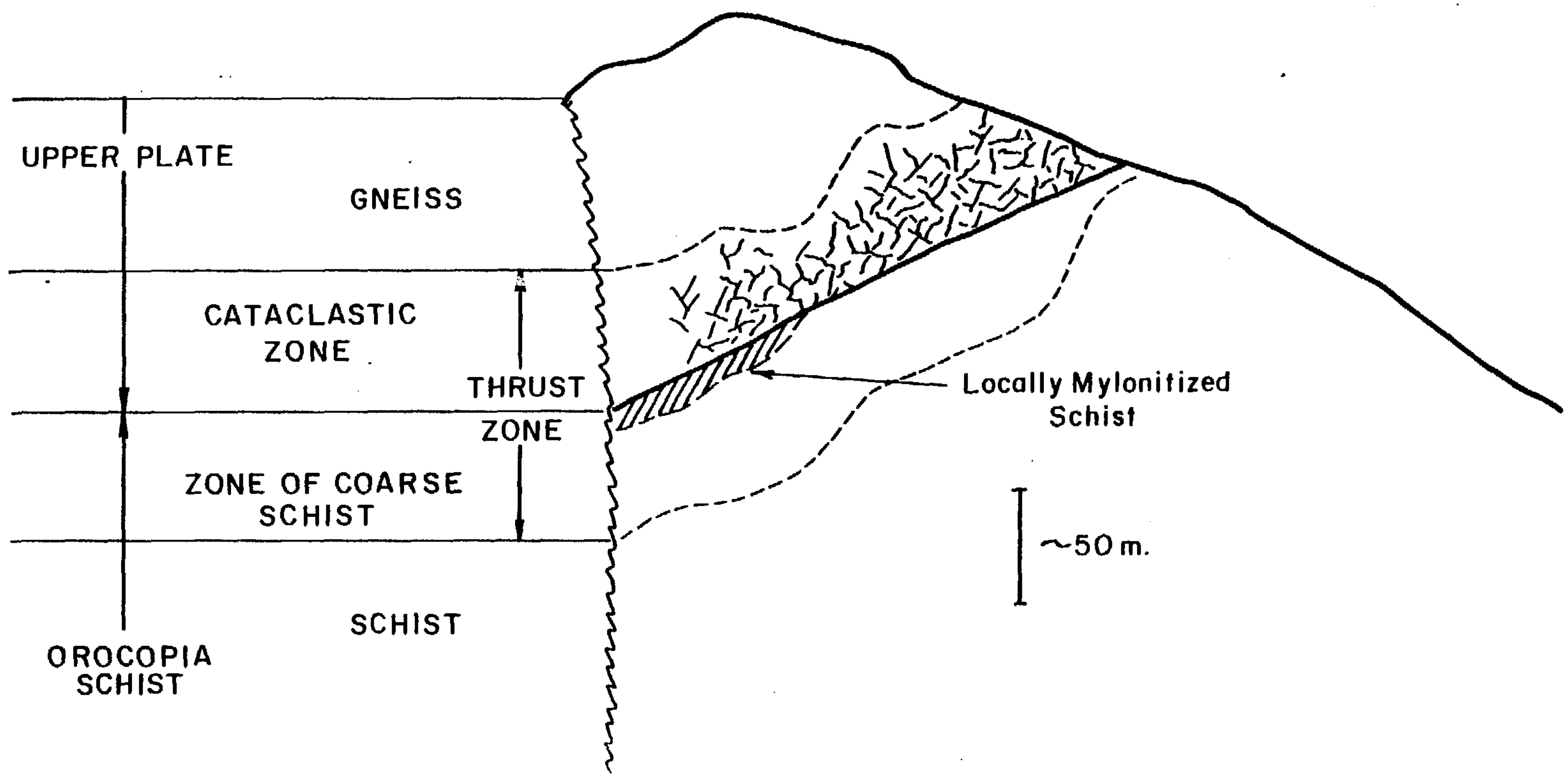


Figure 15 . GENERALIZED CROSS-SECTION OF THE VINCENT-CHOCOLATE MOUNTAINS THRUST ZONE. DASHED CONTACTS ARE GRADATIONAL. (After Haxel and Dillon, 1978)

Over- or underthrusting is believed to have occurred in Upper Cretaceous or Paleocene time. This deformation is dated by resetting of K-Ar age dates in the schist and by ages of the few igneous rocks known to have intruded the thrust plate itself.

The significance of the Vincent-Chocolate Mountains thrust to metals exploration in the region has not been widely recognized. For example, the genesis of the low grade orebody at the Picacho mine has long been an enigma to geologists working in the area. Mineralization at Picacho occurs in altered, broken and cataclastic Precambrian rocks that contain large amounts of hematite and carbonate (see description of Picacho district herein). The Vincent thrust is exposed in nearby windows through the Tertiary volcanic and sedimentary cover and drilling at the mine has shown that the altered, brecciated, and mineralized zones occur stratigraphically above fresh gneisses with often a sharp and abrupt contact separating them. If this contact is of thrust origin, this relationship suggests that structurally prepared zones in the upperplate (possibly along imbricate zones above the main thrust) provided an optimum host for subsequent circulating hydrothermal fluids to dump their mineralization. Another possibility is that the flat, structural(?) bottom to the deposit could be a Tertiary detachment fault. Current reserves in the Picacho mine are about 6 to 7 million tons grading about 0.05 opt gold. Couple these reserves with past production of about 150,000 ounces, plus the potential for further reserves, and this becomes an attractive client-size target.

Likewise, Goldfield's major new discovery (50 to 70 million tons grading 0.05 to 0.07 opt Au) in the nearby "Old Mesquite Diggings" is also hosted in stockworks and fractured gneisses and granitic rocks in the upperplate of the

Vincent-Chocolate Mountains thrust. Minor vein and placer deposits have been explored for years in this area. Gold mineralization occurs with sulfides in veins, stockwork veinlets and as disseminations in the crystalline rocks associated with alaskitic dikes of Laramide(?) age. The sulfide-bearing stockworks and widespread chlorite alteration of the area had some people thinking that it could be the high level manifestation of a buried porphyry copper system during the 1960's and 70's. Conoco made a major examination of the property in the mid-1970's for its gold potential. Extensive trenching and sampling by Conoco, however, narrowly missed the orebody and the property was dropped. Goldfields picked up the property a couple of years ago and has persisted in outlining the major discovery.

Old descriptions of the largest orebody in the Rand district, the Yellow Aster mine, give suggestions that it too is hosted in a tectonically prepared, complex wedge above the Rand thrust, a local equivalent of the Vincent thrust. The Yellow Aster orebody which produced a minimum of 550,000 ounces of gold from 3.4 million tons of ore (about 80% recovery) was contained within a tectonically bounded wedge of quartz monzonite and Rand schist cut by rhyolite dikes. The rocks within the wedge are extremely fractured and shattered and are bounded on top and bottom by low angle faults. The upper bounding fault is definitely pre-mineral, and served to cap and pond the rising hydrothermal fluids. The Rand thrust, which was unknown during the old mining days, crops out about one mile south of the mine. The Yellow Aster mine was essentially high-graded. If it were discovered today with current cutoff grades of 0.01-0.02, it almost certainly would have been in the 1 million ounce gold range.

Thus, the exploration importance of this regionally extensive structure is felt to be hereby established. Aspects of the mineralization found in each of the three deposits discussed have been incorporated into the general model presented below (see Fig. 16).

a.) Competent upperplate Precambrian to Mesozoic (Lower Cretaceous) gneisses and granitic rocks are brittly fractured and cataclastized above the regionally extensive Vincent-Chocolate Mountain Allochthon.

b.) Thermally driven hydrothermal (geothermal) cells related to Upper Cretaceous(?) to late Tertiary intrusion focus metal-rich fluids into the tectonically prepared cataclastic zones above the thrust (and possibly below in places) where physio-chemical changes (i.e., boiling, mixing with meteoric waters, etc.) caused metal precipitation.

Note that while this writer is biased towards the importance of a magma driven hydrothermal system for forming ore deposits, the gold could very well have been derived by leaching from the schists in the lowerplate. The oceanic and greywacke compositon of the protolith would constitute an initially high geologic concentration of gold from which to leach.

The necessity of having an intrusive thermal "engine" to promote fluid circulation or metal leaching still remains however. There has surfaced, a suspicion that late Cretaceous to Tertiary two-mica granites may be important in this regard. The basis for this opinion is documented by Theodore and others (1982) in the Gold Basin-Lost Basin of northwest Arizona. The gold is thought derived either by anatectic incorporation into the deep seated granites, or by means of thermal and aqueous remobilization from host rock adjacent to the granites. Characteristically the gold in these settings is coarse-grained and placer deposits are common lead-ins to the districts. We think

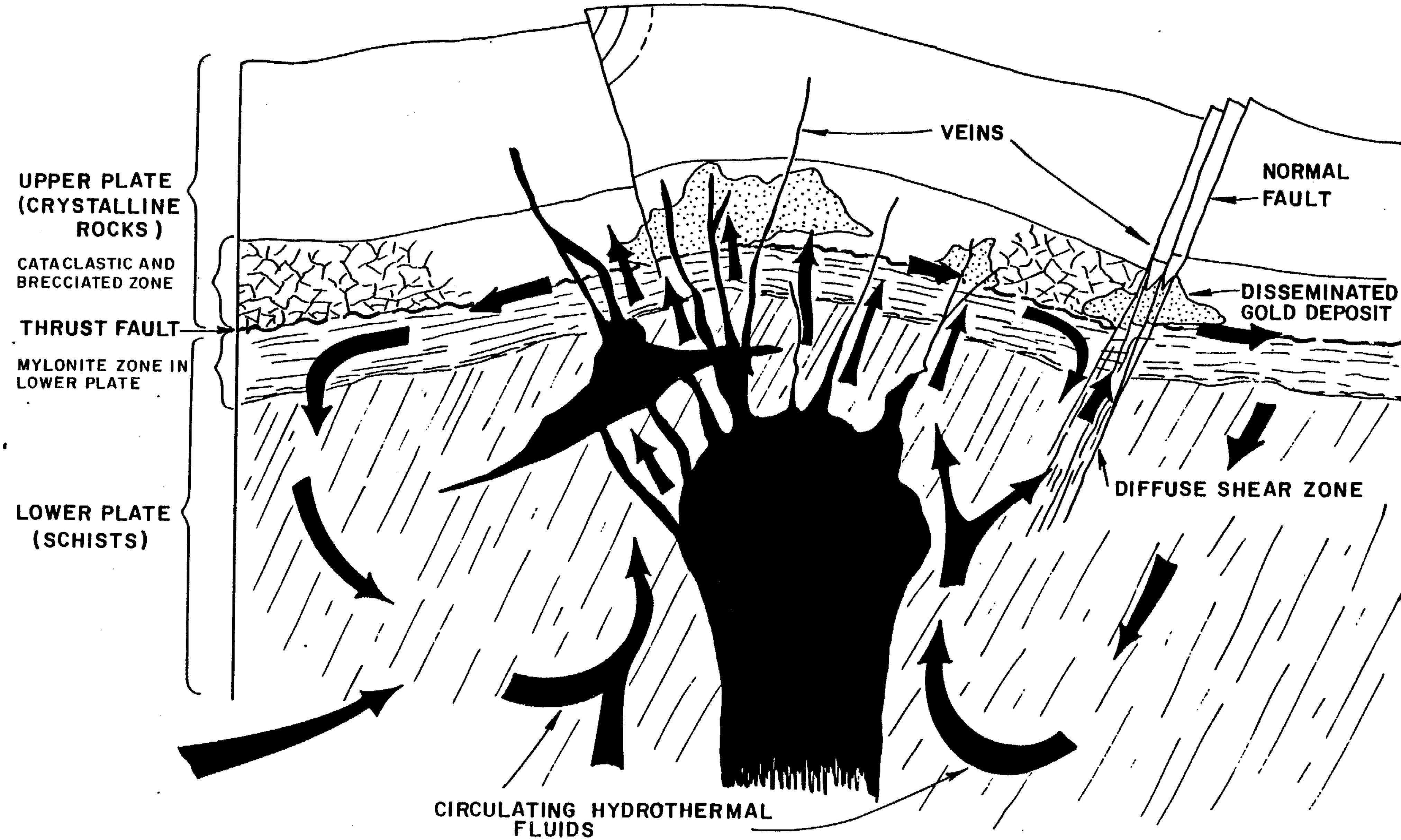


Figure 16. CARTOON DEPICTING MODEL FOR MINERALIZATION IN UPPER PLATE ROCKS OF VINCENT - CHOCOLATE MTN. THRUST.

it noteworthy in this context to observe that gold at the Mesquite deposit is coarse-grained and that a common intrusive type into the lowerplate Orocopia schist is in fact two-mica granite.

It is also interesting to note that the enormous amounts of silicification seen in so many other disseminated deposit types do not appear to be present in these type deposits.

While we have stressed the importance of the Vincent-Chocolate Mountains Allochthon, several other thrust terrains may also possess similar, if somewhat lesser, potential. Cenozoic thrust or reverse(?) faulting along the northern foothills of the San Bernardino Mountains displays widespread low-grade gold mineralization in upperplate Paleozoic marbles in the vicinity of Black Hawk Mountain. Reports have surfaced that possibly as much as 100 million tons averaging 0.03 opt Au have been delineated in one deposit. While this is very low grade, it should be remembered that the very productive open pit gold mines in the Zortman-Landusky district, Montana operate on grades averaging 0.027 to 0.033 opt Au. Similarly, thrust faulting related to the Sevier orogeny (Clark Mountain thrust complex, Old Woman-Piute Mountains thrust zone, etc.); thrust faulting(?) of unknown age in the Cargo Muchacho Mountains (announced reserves at Newmont's American Girl mine contain greater than 300,000 ounces gold); and a thrust in the Bullion Mountains south of Amboy craters all contain significant gold mineralization in places and suggest that these thrust zones should be examined as well. We feel the general model proposed for the Vincent-Chocolate Mountains thrust is also appropriate for these other thrusts as well.

2. Disseminated Deposits of Volcanic-related Hotsprings Origin:

Disseminated, low-grade, bulk tonnage gold-silver deposits formed in volcanic-related hotspring environments have recently become recognized as an economically attractive deposit class. Examples of this type of orebody that have recently been discovered include McLaughlin, CA; Hasbrouck, NV; Borealis, NV; Buckskin Peak, NV; Round Mountain, NV; Thunder Mountain, ID; and Cinola, British Columbia, to name a few. Deposits are of variable size ranging from huge deposits such as Round Mountain (195 million tons averaging 0.04 opt Au) and Cinola (45 million tons averaging 0.054 opt Au) to smaller deposits as Borealis (2 million tons averaging 0.08 opt Au). Grades, while being lower than in the Carlin-type deposits, are usually fairly consistent and can average over 0.10 opt Au such as at McLaughlin (0.16 opt Au) and Thunder Mountain (±0.12 opt Au). Models explaining the geologic characteristics of these deposits have been presented by Buchanan (1981), Berger and Eimon (1982), Strachan and others (1982), Silberman (1982) and White (1982). These works adequately summarize the succinct points of this mineralization and they will not be dealt with in detail in this report. The person looking for an in-depth understanding of these deposits is referred to the references cited.

The general model contains the following essential ingredients.

a.) A geothermal (hydrothermal) cell with focused flow along fault structures or other permeable zones; usually with attending discharge of hotsprings at the surface.

b.) Intermittent self-sealing of the system by formation of silica (+ silicate minerals) cap, allowing pressure and heat buildup which produces resultant multiple events of violent boiling.

c.) Deposition of Au-Ag results from chemical changes accompanying boiling. For example, boiling results in CO_2 + H_2S being partitioned in the vapor phase causing the pH of the remaining liquid to increase causing gold soluble complexes to become unstable.

Certain features such as characteristic alteration zoning and evidence for explosive hydrothermal brecciation (i.e., hydrothermal pebble and breccia dikes) are nearly always present and serve as guides for the explorationist.

From deposits of this type examined by these writers, similar processes appear to be repeated in the geologic history of many of these deposits. The optimal setting typically consists of small or complex basins filled with lacustrine and interbedded volcaniclastic sediments, pyroclastic flows, and volcanic flows and breccias that are intruded by contemporaneous plugs and shallow bodies of generally rhyolitic composition. This setting commonly occurs in an extensional environment and associated volcanic activity is commonly of the alkali-feldspar rhyolite kindred (Wilson, 1983).

Wilson (1983) has discussed the aspects of gold mineralizaton related to the alkali-feldspar rhyolite kindred and some possible reasons why these rocks seem to be favored for associated gold deposits. The tendency for these rhyolites to commonly form plugs, domes and associated local volcanic piles rather than large explosive ash-flows may enhance the ability of these rocks to produce related metal deposits by constraining fluid flow and dispersion in and about the more restricted volcanic centers. This seems to be the case in many of the disseminated hotspring deposits occurring in this setting. Mineralization is often contained within or adjacent to vents, dome complexes, or high-level intrusive bodies. The significance of the associated basins and sediments into which these volcanics are emplaced seems to be one of providing abundant meteoric waters and water-charged sediments in which to easily form convecting geothermal cells. The coarse and porous nature of the volcaniclastic sediments and breccias greatly enhances the permeability of the system, allowing large amounts of fluid flow to be focused into the zone where mineralization may take place.

This basic scenario is repeated in many areas within the Mojave study region. Numerous Miocene to Pliocene basins were forming during late-Tertiary extension in the region. Volcanic activity of rhyodacitic to rhyolitic composition accompanied sedimentation in many of these; much of it being of the alkali-feldspar rhyolite kindred. Associated mineralization is related to these rhyolitic rocks in several areas within the study area (i.e., Mojave, Rand, Loraine, Hart, Hackberry districts; see Wilson, 1983) and the association is probably wider spread than presently recognized.

A major disseminated hotspring gold deposit is believed to exist in the Hart district (Freeport and Noranda) and much additional claim staking has been taking place in nearby volcanic areas within the Lanfair Basin (see Overlay 3). The disseminated silver mineralization in the Calico district, while probably related to andesites rather than rhyolites, also is thought to have formed in a similar setting (Fletcher, 1982). Other evidence for potential disseminated gold mineralization of this type occurs in the tuffaceous sediments near the Rand (Koehn basin; Overlay 3) and Mojave (West Antelope basin; Overlay 3) districts. Other areas where similar potential settings might exist, include the Shadow Mountain, Barstow, Neenatch, Painted Hills, Diligencia, Mojave, Tehachapi, and Ricardo basins (Overlay 3). For example, the Neenatch volcanics and sediments are believed to represent a faulted segment of the Pinnacles volcanic field that has been offset some 300 km along the San Andreas (Crowe and others, 1979). Low-grade disseminated gold mineralization occurs in altered rhyolites in portions of the Pinnacles field, suggesting that similar mineralization could occur in the Neenatch sediments and volcanics as well.

We suggest that exposed sediments, particularly where they are intruded or associated with similar age volcanics, be systematically explored for disseminated hotspring type mineralization. One method in which to facilitate rapid reconnaissance of these areas would be to first fly over them in light aircraft or helicopter noting any areas of obvious bleaching or argillic alteration. These areas could then be field checked and sampled on a priority basis. The only way to check some areas, of course, will be by actual ground reconnaissance.

Several areas have been given a greater potential than the rest. These are shown on Overlay 7.

3. Breccia Hosted Deposits:

This group of deposits as proposed by Sillitoe (in press) is one in which nearly all of the gold is contained in hydrothermal or intrusive breccia masses. It is distinguished from volcanic- and intrusive-hosted types where a small part of the gold may occur in hydrothermally brecciated rock, but where most of the mineralization occurs in the surrounding wallrocks. Included in this group are two basic classes of deposits; breccia pipes and hydrothermal intrusion breccias. Breccia pipes are elliptical to circular in plan and can be of a collapse or intrusive origin. Hydrothermal intrusion breccias are characterized by angular to rounded fragments of usually several types of rocks cemented by rock flour or cryptocrystalline silica and sulfides. Mineralization can occur in the matrix, in later stockwork veinlets, or in open voids between fragments. Intrusion breccias can form breccia pipes, but they are commonly much more irregular in form. Breccia hosted deposits are believed to be able to form as the result of several different processes including the explosive release of volatiles from a cooling pluton, by phreatic explosions or by phreatomagmatic activity associated with near surface volcanic phenomena (Wilson, in prep.).

Several deposits of this type located in the western U.S. are presently in production or preproduction development. Examples include the Ortiz deposit, NM (8 million tons averaging 0.055 opt Au; Woodward and others, 1979; Bonham, 1981); Iron Clad breccia pipe, CO (4 million tons averaging 0.06 opt Au); and Golden Sunlight deposit, MT (25.8 million tons averaging 0.05 opt Au; Garwood, 1981).

While targets of this type are relatively small and difficult to explore for, they can be highly attractive economically. Two breccia hosted deposits (Bagdad Chase mine and Colosseum mine) are known to exist within the study area; a third (Lucy Gray mine; see Clark-Ivanpah district herein) which may be a "sleeper" deposit lies in Nevada just across the California border. In addition, two highly silicified, molybdenum-bearing breccia pipes are known to exist in the Northern Providence and New York Mountain ranges. While these are not known to be gold-bearing, one wonders if they have ever been examined for this potential.

The Bagdad Chase mine in the Stedman district occurs in a Tertiary hydrothermal breccia sill that has produced somewhere between 120,000 to 290,000 ounces of gold from ore that averaged about 0.30 opt Au (see Stedman district herein). The Colosseum mine in the Clark Mountains explores disseminated gold mineralization within a felsite breccia pipe complex of Cretaceous age (see Clark-Ivanpah district herein). Exploration drilling prior to 1982 delineated over 8,000,000 tons of ore averaging about 0.05 opt Au with about 9,000,000 tons of probable ore averaging between 0.3 to 0.05 opt Au. Amselco currently has an option on this property and is actively drilling more holes.

Although no potential targets of this type (except the Lucy Gray and possibly the two in the New York and Providence Mountains) were delineated during the course of this project, we recommend that client be aware of this deposit class while they explore in other mineralized terrain in the project area.

4. Metamorphic Core Complex (MCC) Model:

Mineralization in this setting is stringently controlled by detachment discontinuities bordering certain margins of the core complexes. Epithermal mineral fluids are believed derived in part from thermal and deformational processes (mylonitization) within the lowerplate which become emplaced within the superjacent brecciated detachment zone as a sulfide-porpylitic alteration assemblage. In addition, levels of detachment are thought shallow enough to be intermediate between the rising metamorphic waters and descending meteoric systems. Hotsprings mineral occurrences dominated by exhalative carbonate deposits and siliceous sinter are known just above the detachment fault in permeable and sometimes carbonaceous upperplate rocks.

The optimal environments for larger, precious metals targets are:

a.) Highly brecciated, middleplate sequences up to hundreds of feet thick which are structurally interleaved between mylonites and unmetamorphosed upperplate rocks.

b.) Carbonate-silica hotsprings systems of the upperplate which are exhaled in lacustrine, carbonaceous portions of syn-detachment sedimentary sequences such as the Gene Canyon, Copper Basin-Chapin Wash or Artillery Formations in southeast California and western Arizona.

c.) Zones of structural intersection between through-going upperplate listric veins or structures and the flat detachment zone itself. During the process of listric tilting of upperplate blocks, extreme shattering in rather uninhibited local areas just above the detachment zone occurs in order to accomodate for room problems inherent to this style of faulting (Gross and Hillemeyer, 1982). Any veins which are found above the actual detachment zone may be expected to widen and enlarge significantly at their intersection with the detachment zone. We have seen this, in fact, demonstrated at the Silver Bell prospect, northwest of Republic, WA. and at the Copper Basin copper-gold deposit at the east edge of the Whipple metamorphic core complex.

The favored MCC settings as well as others are shown diagramatically in Figure 17. The entire subject of this mineralization model is developed at length in the recent special topic report by W. Rehrig.

5. Triassic-Jurassic Alkali-Magmatic Model:

In the central part of the San Bernardino sheet as perhaps in scattered other localities through the Mojave, are exposures of early Mesozoic volcanic (metavolcanic) rocks and associated plutonic equivalents which are deemed extremely favorable for porphyry or subvolcanic (i.e. breccia, etc.) copper-gold or gold systems. The extrusive host rocks for this setting are alkali-basalts and rhyolites, essentially bi-modal, into which are intruded fairly primitive, basic to intermediate magmas. Of particular interest are the late-stage alkali trachytes, syenites or granitic differentiates of the

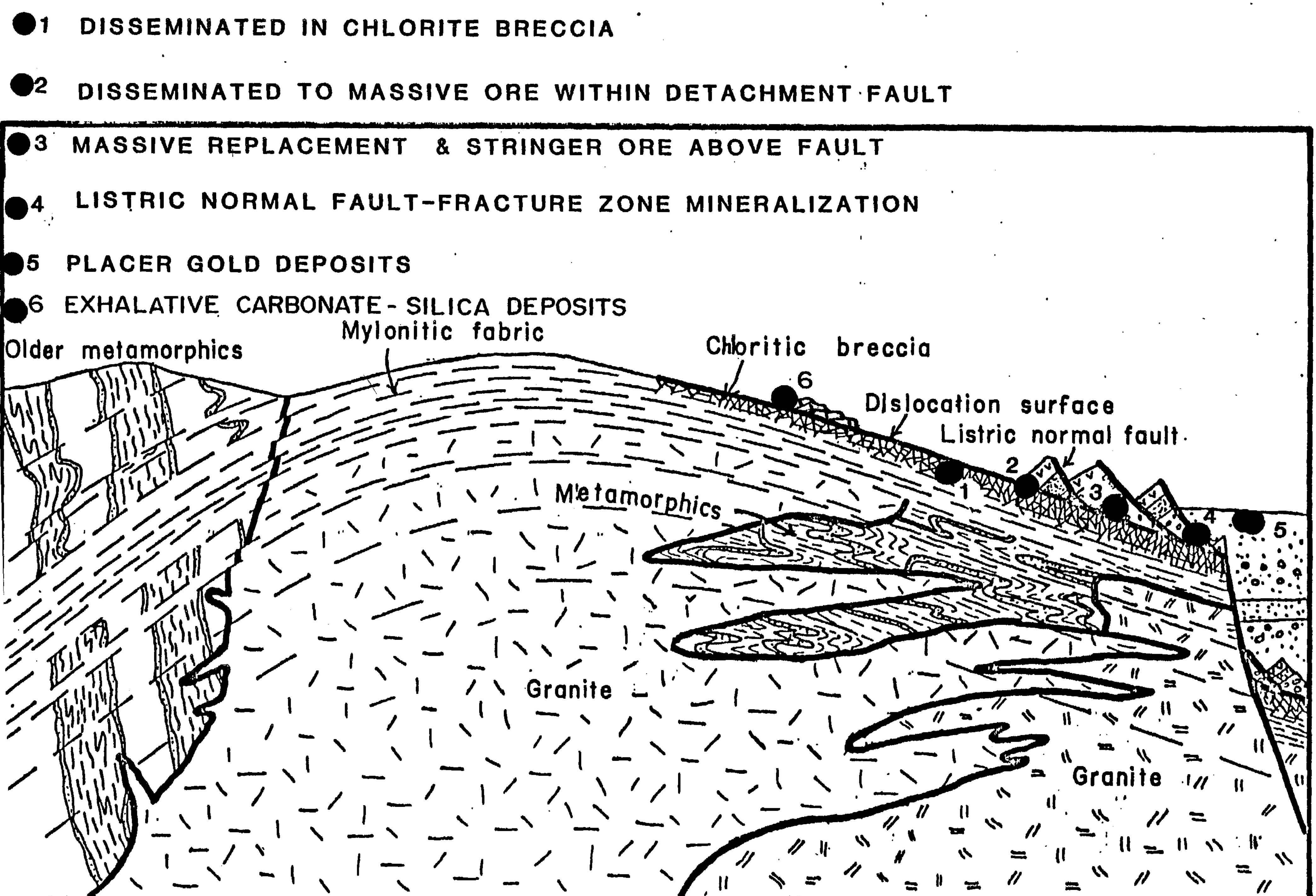


Figure 17. Settings of Mineralization in the metamorphic core complexes.

plutonic series, which commonly give rise to intense albitic alteration and copper-gold mineralization of late magmatic to hydrothermal origin.

These systems evolved in an oceanic setting and quite often, discontinuous marine carbonate deposits are intercalated with the volcanics. The bi-modal petrology of the volcanics argues for a rift tectonic setting rather than the calc-alkaline generative subduction arc environment. In the Mojave, representatives of this setting are the Ord Mountain Group (Ord, Newberry and Rodman Mtns.) and the Sidewinder Volcanics (Sidewinder Mtn. area). There may be others.

Descriptions of the well mineralized Ord Mtn. district, as well as other references in the Mojave, convince us that these rocks and associated metals can be correlated with like features in northern Washington and British Columbia. There, gold or copper-gold districts like Boundary, Rossland, Bridge River and Hedley or, in Washington, the Oroville-Nighthawk districts, not to mention auriferous porphyry copper deposits, exemplify the metallogenic favorability of this lithotectonic assemblage.

In many ways, the environment resembles the highly productive rift and bi-modal setting of the Abitibi gold belt in eastern Canada. The discovery of analogs in the Mojave province is exciting in that this recognition has probably escaped the Southwest exploration community and thus has been greatly underprospected.

Properties of the Triassic-Jurassic alkalic ore model are as follows:

a.) Fairly primitive, basic magmatism within oceanic crust, host settings geochemically high in copper and gold.

b.) Intrusive activity co-genetic and spatially coincident with reactive and permeable extrusive equivalents.

c.) Differentiation of alkalic-rich plutonic phases enriched in halides, carbonate and metals.

d.) Late stage magmatic to hydrothermal evolution of deuteric(?) fluids which result in intense albitization or soda metamorphism of enclosing calcium-rich host rocks. This alteration creates minerals such as albite, chlorite, epidote, quartz, carbonate and sulfides, and may initially be enhanced by components of sea water circulation.

e.) A very consistent copper-gold metallic association, in systems rich in carbonate and poor in total sulfide content. Oxide mineral phases of iron (i.e. magnetite-hematite) are commonly present.

REGIONAL GEOCHEMISTRY

As part of the regional metallogenic analysis, multi-element stream sediment geochemical data (HSSR) were obtained from the National Uranium Resource Evaluation (NURE). A standard statistical analysis was applied to each element in each of the data sets. This analysis provided the following parameters for each element: Mean, mode interval, maximum and minimum value, range, standard deviation, skewness, kurtosis, number of samples below detection limit, number of missing values, and a site-by-site list of sample points above the 90th, 95th, and 99th cumulative frequently percentiles. In addition, a Pearson Product Moment Correlation Coefficient Matrix was provided for the entire range of elements in each AMS sheet.

Stream sediment data were not available for all the AMS sheets in the Mojave project; only the Kingman, Bakersfield, Salton Sea, San Bernardino, Trona and Needles sheets are presently completed. Of these sheets, all but Kingman were analyzed by SRL (Savannah River Laboratories). The Kingman data was analyzed by Lawrence Livermore Labs. Different techniques were used for analysis by each lab; Table 1 lists the analytical procedure and sensitivity limits used by each facility for the individual elements.

The quality of the data remains to be tested. Discussions with researchers in the U.S. Geological Survey working on this problem indicate that the neutron activation technique has interference problems for a variety of elements, including gold and silver. The problem was apparently more acute at the beginning of the program and particularly with Lawrence Livermore Labs. SRL had apparently solved of this same problem in their later work.

TABLE 1. SEDIMENT ANALYSES BY HSSR LABORATORIES

ELEMENTS*

Laboratories		Ag	Al	As	Au	B	Ba	Be	Bi	Br	Ca	Cd
Lawrence Livermore Laboratory		3.0 NA	50.0 NA	3.0 NA	0.015 NA		100.0 NA			1.0 NA	5000.0 NA	
Los Alamos National Laboratory		5.0 XRF	200.0 NA	5.0 XRF	0.01 NA		300.0 NA	1.0 AS	5.0 XRF		4000.0 NA	5.0 XRF
Oak Ridge Gaseous Diffusion Plant		2.0 PS	500.0 PS	0.1 AA		10.0 PS	2.0 PS	1.0 PS			500.0 PS	
Savannah River Lab	(1) SRL standard suite		300.0 NA		0.01 NA							
	(2) SRL supplemental suite	0.1 AA		1.0 AA			8.0 AA	0.5 AA			100.0 AA	
	(3) Analyzed by Oak Ridge as supplemental data	2.0 PS	50.0 PS			10.0 PS	2.0 PS	1.0 PS			50.0 PS	

Laboratories		Ce	Cl	Co	Cr	Cs	Cu	Dy	Eu	F	Fe	Hf	Hg	K	La	Li	Lu	Mg	Mn	Mo	Na
Lawrence Livermore Laboratory		15.0 NA	50.0 NA	3.0 NA	5.0 NA	1.5 NA		0.2 NA	0.1 NA		2000.0 NA	1.0 NA	500.0 NA	2000.0 NA	0.3 NA		0.07 NA	50.0 NA	200.0 NA		20.0 NA
Los Alamos National Laboratory		10.0 NA	80.0 NA	0.7 NA	5.0 NA	1.3 NA	10.0 XRF	2.0 NA	0.8 NA		2000.0 NA	1.0 NA		2000.0 NA	6.0 NA	1.0 AS	0.1 NA	1238.0 NA	10.0 NA	5.0 XRF	150.0 NA
Oak Ridge Gaseous Diffusion Plant		10.0 PS	- PS	4.0 PS	1.0 PS		2.0 PS				500.0 PS	15.0 PS		500.0 PS	2.0 PS	1.0 PS		500.0 PS	4.0 PS	4.0 PS	500.0 PS
Savannah River Lab	(1) SRL standard suite	3.0 NA						1.7 NA	0.2 NA		2800.0 NA	1.0 NA			2.0 NA		0.1 NA		70.0 NA		800.0 NA
	(2) SRL supplemental suite			5.0 AA	49.0 AA		6.0 AA							2000.0 FE		5.0 FE		300.0 AA		2.0 AA	
	(3) Analyzed by Oak Ridge as supplemental data	10.0 PS		4.0 PS	1.0 PS		2.0 PS				50.0 PS	15.0 PS		50.0 PS	2.0 PS	1.0 PS		50.0 PS	4.0 PS	4.0 PS	50.0 PS

Laboratories		Nd	Ni	P	Pb	Rb	Sb	Sc	Se	Si	Sm	Sn	Sr
Lawrence Livermore Laboratory						20.0 NA	0.5 NA	0.1 NA			0.5 NA		40.0 NA
Los Alamos National Laboratory		20.0 XRF	15.0 XRF		5.0 XRF	25.0 NA	1.0 NA	0.1 NA	5.0 XRF		0.5 NA	10.0 XRF	203.0 NA
Oak Ridge Gaseous Diffusion Plant		4.0 PS	2.0 PS	5.0 PS	10.0 PS			1.0 PS	0.1 AA	- PS			1.0 PS
Savannah River Lab	(1) SRL standard suite							0.4 NA	- NA		1.0 NA		
	(2) SRL supplemental suite	5.0 CM	5.0 AA	20.0 CM	10.0 AA			1.0 AA	1.0 AA			5.0 AA	50.0 AA
	(3) Analyzed by Oak Ridge as supplemental data	4.0 PS	2.0 PS	5.0 PS	10.0 PS			1.0 PS					1.0 PS

Laboratories		Ta	Tb	Th	Ti	Tl	U	V	W	Y	Yb	Zn	Zr
Lawrence Livermore Laboratory		0.5 NA	0.4 NA	2.0 NA	10.0 NA		2.0 DNC	0.5 NA	0.5 NA		1.0 NA	30.0 NA	
Los Alamos National Laboratory		1.0 NA	1.0 NA	0.8 NA	200.0 NA	- NA	0.02 DNC	5.0 NA	15.0 XRF	- NA	1.2 NA	20.0 NA	5.0 XRF
Oak Ridge Gaseous Diffusion Plant				2.0 PS	10.0 PS		0.02 NA 0.25 FL - MS	2.0 PS		1.0 PS		2.0 PS	2.0 PS
Savannah River Lab	(1) SRL standard suite			2.0 NA	300.0 NA		0.4 DNC	20.0 NA			1.3 NA		
	(2) SRL supplemental suite			70.0 XRF			0.1 FL		2.0 CM	5.0 AA		11.0 AA	
	(3) Analyzed by Oak Ridge as supplemental data			2.0 PS	10.0 PS			2.0 PS		1.0 PS		2.0 PS	2.0 PS

* NOTE: Actual elements analyzed may vary for each quadrangle.

** = The minimum detection given for SRL data may or may not be the minimum detection for that element. The number could be the lowest value detected and, therefore be greater than the minimum detection.

CODES

- Minimum detection values are in parts per million.
- A " - " in the minimum detection slot indicates missing data or that no minimum detection was given.
- AA = Atomic Absorption
- AS = Arc Source Emission Spectrometry
- CM = Colorimetry
- DNC = Delayed Neutron Counting
- FE = Flame Emission
- FL = Fluorometry
- MS = Mass Spectrometry - Isotope Dilution
- NA = Neutron Activation Analysis
- PS = Plasma Source Emission Spectrometry
- SP = Spectrophotometry
- XRF = Energy Dispersive XRF

All of the AMS sheets which were run for gold in the Mojve project were analyzed by SRL. Most, if not all of the work was done in 1981.

After the statistics were run and the data reviewed, it was decided to plot anomalous values for only gold, silver and the major pathfinder elements. This was mainly due to budgetary and time constraints on the project. A more rigorous study and plotting of additional elements or element ratios could prove to be of significant use in the future. For this reason, the total statistical data base will be forwarded to client for any further consideration they may desire. For instance, plots of the elements Cu, Pb, Zn, Mo, and W may ultimately prove useful.

The elements plotted on Overlay 6 include Au, Ag, As, Hg, Sb, and Se. Not all of these elements were analyzed for each AMS sheet. For example, of these elements, only Au was analyzed for on the Trona sheet, while on the Kingman sheet Ag, As, Sb, and Hg were analyzed, but not Au.

It should also be noted that on Overlay 6 only the Au symbols represent consistent values across the entire area. For Au we have plotted three anomalous intervals: detection to 0.1 ppm; 0.10 to 0.3 ppm; and greater than 0.3 ppm. For the other elements, only the 99th and in some cases the 95th cumulative frequency precentile values were used to indicate anomalous samples. The absolute value range of each percentile for each element is somewhat different for each AMS sheet. The various ranges for these values in each sheet are presented in the Legend to Overlay 6.

The following elements were plotted:

Kingman Sheet:	Ag, As, Hg, Sb
Needles Sheet:	Au
Salton Sea Sheet:	Au, Ag, As
San Bernardino Sheet:	Au
Trona Sheet:	Au
Bakersfield Sheet:	Ag, As, Se

We found it useful to integrade the Precious Metals Overlay 4 in conjunction with the NURE geochemistry to better understand the distribution of the anomalous elements.

Results

1. Kingman Sheet:

The Kingman sheet holds numerous anomalous samples of silver, arsenic, mercury, and antimony. The significance of individual point anomalies is hard to ascertain. What is of interest, however, is the clustering of anomalies around certain areas and particularly individual points that display two or three anomalous elements.

For example, the Hart district which has recently witnessed a claim staking war between such companies as Freeport and Noranda over a beautifully exposed gold-bearing fossil hotsprings system, stands out like a "sore thumb" on Overlay 6 as a cluster of antimony and arsenic anomalies. Three mercury anomalies occur in the same area; one out in the playa, apparenty draining the Hart area, but two others occur in silicic volcanic rocks similar to those found at Hart.

The Hackberry district south of the Hart district is displayed by a single antimony anomaly. This is another area where large amounts of silicification and sporatic gold mineralization occurs in rhyolitic volcanic rocks and sediments. It is an area that definitely needs to be examined further.

Elsewhere within the Kingman sheet, anomalous mercury values occur in Precambrian crystalline rocks on the east side of Ivanpah mining district, and an arsenic and antimony anomaly exists on the west side of the district draining the thrust faulted Paleozoic carbonate sequence.

A single point arsenic anomaly occurs in interbedded Tertiary sediments and silicic volcanic rocks in the Shadow Mountain district. Significant silicification is known to occur locally in these rocks (see district description herein). This would also appear to be an area highly deserving of on site follow-up.

Samples draining Paleozoic and Precambrian rocks south and west of the Old Dad district show consistent arsenic anomalies.

Anomalous antimony and mercury samples seem to correspond with the Halloron Springs district. Two of the anomalies appear to lie on the edge of a small block of Tertiary sediments and interbedded volcanics, suggesting that they too may merit reconnaissance examination.

While a very large number of the anomalous samples fall outside the study area, they have been left on the map for clients to use as they see fit. We recommend that any of the points displaying two and three anomalous pathfinder elements be checked out. Some will obviously be from samples draining known mining districts, such as the arsenic, antimony and silver anomalies in the nearby Oatman mining district of Arizona. Anomalous clusters that can't be readily accounted for (i.e., where no mines may exist) should be ground checked.

2. Needles Sheet:

Of the total suite of elements plotted on Overlay 6 only gold was analyzed for in the Needles sheets. Most of the anomalies correspond with areas in which numerous gold prospects occur. Geologically, some of these are interesting, such as the large number of anomalous samples that occur around the margins of the Whipple and Chemehuevi metamorphic core complexes. Another interesting cluster of anomalous samples occurs at the northern end of the Dale mining district.

Two anomalous samples occur in the southern half of the map and seem to be associated with Laramide age granitic rocks. No known gold mines appear to occur with these samples, making them hard to explain. It may be worthwhile to field check these areas.

Another area that would appear to warrant additional examination is the 0.1 to 0.3 ppm anomaly that occurs in felsic volcanic rocks in the Old Dad Mountains (northeastern portion of the Needles sheet). No known mines appear in this area. It is possible that a volcanics related hotspring type setting could exist in this area.

3. Salton Sea Sheet:

The Salton Sea sheet represents the only sheet within the Mojave project where both gold and several of the pathfinder elements have been analyzed for. As a result, several interesting clusters of anomalies can be distinguished on this sheet.

Samples taken from streams and playas draining the southern Chocolate Mountains area display numerous arsenic and gold anomalies. This is significant as it suggests that mineralization such as that occurring in the Mesquite and Picacho orebodies may be explored for using arsenic geochemistry. There are several examples of anomalies occurring in upperplate crystalline rocks near exposures of the Vincent thrust. Unfortunately, most of these are within the Chocolate Mountains Gunnery Range.

Another cluster of gold and arsenic anomalies occurs in the southern Chuckwalla Mountains and Black Hills area. Many of these anomalies occur in areas of no known gold mining activity within the Palo Verde volcanics. The Palo Verde volcanics are largely composed of silicic flows and tuffs that are intruded by numerous rhyolitic bodies and domes. Abundant chalcedony nodules occur in gravels shed from these volcanic rocks in the southern Chuckwalla Mountains (see Chuckwalla district herein) and suggest that possibly hotsprings type occurrences may exist in these volcanics. This area of silicic volcanics would appear to be one that definitely needs to be checked out in more detail.

The third interesting zone of anomalies occurs along the northern edge of the Jurassic McCoy basin in the northern Palen Mountains, the Little Maria Mountains and the northern McCoy Mountains. This area consists of a complex zone of thrusting along the McCoy Basin suture zone that has been intruded by Cretaceous and Tertiary igneous bodies. Numerous gold, silver, arsenic and selenium anomalies occur across a broad zone in this area. Interesting gold and silver anomalies occur along a thrust zone intruded by a mid-Tertiary body in the central part of the Little Maria Mountains. An arsenic-silver anomaly occurs just south of this area in Paleozoic carbonate rocks. No gold prospects are known to exist in this region. Silver and selenium anomalies appear to cluster around Cretaceous intrusive rocks in the southern Maria and northern McCoy Mountains.

4. Trona Sheet:

Like the Needles sheet, only gold has been plotted on the Trona sheet. Anomalies appear to be fairly scattered, usually being explainable by nearby gold mines or prospects (i.e., anomalies in Rand districts). Several anomalies occur within the Naval Weapons Testing Range and will not even be mentioned. Interestingly, several of the anomalous samples occur in Tertiary sedimentary (and interbedded volcanic) rocks that were deposited within the Barstow and similar basins. Examples include the anomaly north of Fremont Peak, the anomaly in sediments and volcanics rocks north of Opal Mountain, the anomaly in sediments along the complex Las Vegas thrust zone just west of Baker, the greater than 0.3 ppm anomaly in the Ricardo sediments in the northern part of the El Paso Mountains (note that placer gold is widespread in the El Paso's and may account for this anomaly), and possibly the anomaly in the Afton canyon area in the Cady Mountains. All of these anomalies should probably be examined for disseminated gold potential.

Another interesting anomaly centers around several small rhyolitic intrusions in the Grapevine district north of Barstow. Also in this area there is an anomaly that is associated(?) with Paleozoic eugeosynclinal rocks which are not in the vicinity of any known mines.

Yet another anomaly situated far from any known mineralization occurs in volcanic rocks north of the Blackwater fault and west of Granite Mountain.

5. San Bernardino Sheet:

Of the six elements plotted, gold was the only one analyzed for in the San Bernardino sheet. Numerous anomalies of the 0.1 to 0.3 ppm and greater than 0.3 ppm occur on this sheet. Again, most of these are associated with known mineralized areas.

An interesting anomaly occurs in Tertiary sediments south of Barstow and north of the Ord district. Having briefly driven through this area, Wilson has observed that interesting volcanic rocks and vents occur in this area.

Two gold anomalies occur in Paleozoic eugeosynclinal rocks west of the Oro Grande district in the southern Shadow Mountains. Previous mining activity in this area has explored Pb-Zn-Ag replacements in limestones associated with felsite dikes and fluorite-calcite veins. Gold occurrences similar to those in the eugeosynclinal rocks of the El Paso Mountains could be present.

Two anomalies in Precambrian crystalline rocks may be in upperplate rocks overlying the Vincent thrust south and east of Mount Baldy. No known gold mines occur in the vicinity of either anomaly and suggest this could be a potential "sleeper" area along the Vincent thrust that should be checked out.

Numerous anomalous samples occur in the streams draining the northern part of the San Bernardino Mountains. Significantly, the mineralized thrust and slide zone near Black Hawk show up as an anomaly. Of particular interest is a similar thrust zone south of the Black Hawk area cutting through Gold Mountain. Mineralization also occurs along this area and a large stream sediment anomaly exists as well. This anomaly should be definitely examined; as should both of these thrust zones.

Another interesting anomaly drains volcanic rocks cut by rhyolite intrusions in the Bullion Mountains south of the Stedman district. This area, unfortunately, is within the Marine Corps. Gunnery Range.

6. Bakersfield Sheet:

NURE HSSR samples were taken across the entire Bakersfield sheet. Apparently only about half of these, however, were analyzed or reported at the time this project was undertaken. All the samples within the Mojave project area were part of this unreported sample lot. This is extremely unfortunate as this is a high priority area. Samples north of the map area that are reported have been plotted for client's convenience. It was reported to us that the samples for this area of interest may have been sent to some other lab and may be reported in a different report from that which we purchased. This should be investigated further. We would recommend for the relatively cheap expense of plotting the data, that if these sample localities are available they be purchased and integrated into future follow-up in this area.

EXPLORATION-TARGET DELINEATION

The Mojave study area is a known gold province. Within the area of interest there are two districts (Rand and Mojave) which have had historical production between 750,000 to 1,000,000 ounces of gold. At least five other districts (Cargo Muchacho, Picacho, Stedman, Holcomb Valley, and Mount Baldy) have produced greater than 150,000 ounces of gold in the past. Several other districts (i.e., Loraine, Acton, Baldwin Lake and Dale) have had historical production in the 50,000 to 100,000 ounce category.

With the deregulation and rapid rise in gold prices since 1971, significant new discoveries in old producing districts have been made. These include:

	Property	Size	Grade
1.	Mesquite (Goldfields)	50-70 million tons;	0.05-0.07 opt Au.
2.	Colesseum (Draco & Amselco)	8 million tons (proven), 8-10 million tons (probable)	0.05 opt Au. 0.03-0.05 opt Au.
3.	American Boy-American Girl (Newmont)	Unknown	Announced reserves of more than 300,000 oz. of contained gold. Continued exploration is believed to be enlarging this figure.
4.	Picacho (Chemgold)	6-7 million tons	0.05 opt Au.
5.	Black Hawk	Presently unsubstantiated reports indicate reserves have been outlined in this area amounting to 100 million tons grading 0.03 opt Au.	
6.	Hart (Freeport)	As of yet unexplored, but displays all the appearances of being a major disseminated hotspring type deposit.	

Thus, we feel the potential of the Mojave area is justly established. We would further contend that although the recent discoveries are drawing much deserved new attention into this region, the area has been virtually untouched with regard to any modern systematic exploration approach.

In this, the last section of this report, we will deal with the matter of prioritizing areas within the study region that we feel offer the best chances for finding new gold reserves of a size suitable to meet client's development and mining requirements. The figure that has been told to us and on which we have based our suggestions and models is that of a desired target size of one million ounces of gold. While gold deposits occur in many different environments and vary widely in size and grades, the magnitude of this desired target virtually eliminates from consideration many of the common deposit types encountered in the Mojave area. For example, the hundreds of small deposits consisting of mineralized fissure and shear zones that occur throughout the study area are of little economic interest by themselves. There are certain exceptions, of course, such as where sufficient widths of mineralization occur along these zones to make them of interest. We have tried to flag these types of occurrences in the "Mines of Interest" sections within the individual district descriptions. We believe that many of these are of sufficient interest to warrant some form of reconnaissance follow-up.

After compiling and studying the great amount of regional and local geologic-metallogenic data for the Mojave study region, we are of the opinion that the main potential for the area falls within several distinct environments that repeatedly occur and which exhibit the type of "permissive" geologic settings in which one would expect to find major bulk-tonnage gold deposits.

In fact, major deposits occurring in two of these "permissive terrains" are presently known to exist within the study area or in similar settings in other areas.

The two most important of these settings are the regionally extensive Vincent-Chocolate Mountain allochthon terrain and the late Tertiary basins which display associated and contemporary rhyolitic volcanism. Other favorable terrains and models include other zones of thrust faulting, porphyry "style" Au-Cu deposits in the Sidewinder Volcanic Series, and detachment zones related to metamorphic core complexes. Since these terrains, and models relating to mineralization within them, have been previously discussed in the preceeding Metallization Summary portion of this report, they will not be repeated here.

As a result of this overall tectonic-metallogenic analysis we can recommend some specific known districts or clusters of occurrences falling within these "permissive terrains." We strongly urge, however, that a method of systematic exploration be undertaken in examining these "broader" geologic settings in general, in order to utilize to full advantage the exploration models and concepts felt to apply to these areas.

We have displayed these priority target areas on Overlay 7. Individual mines recommended for furether evaluation are not shown on this overlay due to their small size. Legal locations are given for each of these in the district descriptions in which they occur.

Favorable Target Areas: (See Overlay 7)

1. <u>Vincent-Chocolate Mountains Allochthon:</u>

As a result of this study, we feel a newly recognized deposit class may exist in the Mojave study area. Deposits of this type are thought to occur as stockworks and disseminations in brecciated and cataclastic gneisses and plutonic rocks in the upperplate of the Vincent-Chocolate Mountains thrust. We feel that the newly discovered Mesquite deposit (Goldfields Co.) in the Chocolate Mountains, the Picacho mine (Chemgold) northwest of Yuma, and probably the Yellow Aster mine in the Rand district represent mineralization formed in this setting.

The Vincent-Chocolate Mountains thrust is regionally exposed in the study area along the San Andreas and Garlock fault systems. Gold mineralization occurs in upperplate rocks in close proximity to the thrust in several different areas. We feel that all known mineralization and NURE HSSR geochem anomalies in upperplate rocks close to this thrust zone should be thoroughly examined.

a. Chocolate Mountains district.

Upperplate rocks are well exposed in the Chocolate Mountains district and numerous mid-Tertiary igneous rocks cut the thrust zone. Numerous gold occurrences are found in these upperplate rocks. With the discovery of the Mesquite deposit and its close proximity to the Picacho and Cargo Muchacho districts, this area is receiving very close scrutiny by numerous mining companies. We do not know of any of them, however, who are using or are aware of this particular model (with the possible exception of Goldfields).

Systematic evaluation of gold occurrences in the upperplate rocks in this district should be undertaken. Several mines of interest are listed under the district description.

b. Dos Palmas district.

This is a very old mining district of which little modern information is known. The Vincent thrust is exposed along the entire length of the Orocopia Mountains and some mineralization is known to be present in upperplate Precambrian rocks. Since there has been little known production from this area it has probably received little or no recent exploration activity.

c. Dunlop Acres areas.

Several outcrops displaying the thrust occur in this area east of Redlands. While no mining districts are known to exist in this region, a single gold mine occurs in the upperplate gneisses and suggests that mineralization could be present.

d. Mount Baldy district.

The density of gold occurrences (including placers) in upperplate rocks near the thrust zone is impressive. Several granodiorite bodies intrude the thrust in the district and could have provided the heat necessary to circulate hydrothermal cells. Because placers are restricted to streams draining the upperplate rocks in the vicinity of the thrust it suggests that stockwork type ore could exist in this area. Such mines as the Allison, Baldora, Native Son and others (see district description) were developed on mineralized zones containing discontinuous quartz stringers and sulfides. This district should be thoroughly and systematically examined.

e. Acton district.

The Acton district is a very old mining area visible from the highway going from Los Angeles to Palmdale. Numerous mines in the area had production and two have been credited with more than $500,000 each. What is interesting is that at least some of the mines are hosted by Precambrian igneous rocks in the upperplate of the Vincent thrust. Mineralized zones and areas closer toward the thrust plate should be examined for Mesquite and Picacho type mineralization.

f. Rand district.

Crystalline rocks in the upperplate of the Rand thrust (Vincent equivalent) should be examined for mineralization similar to that found at the Yellow Aster deposit. Since most of the thrust is exposed south of the main producing areas, prior mining claims would likely not present a problem.

2. <u>Terrain with disseminated hotspring deposit potential</u>:

Disseminated, low-grade gold-silver deposits formed in volcanic-related hotspring environments have recently become recognized as an economically attractive deposit class. A common thread relating many of these deposits consists of a geologic setting in which porous volcanoclastic and lacustrine sediments deposited in small or complex basins are intruded by contemporaneous plugs and shallow bodies of generally rhyolitic composition. The general model of deposit formation in this setting consists of the development of a shallow hydrothermal system in permeable rocks that is repeatedly sealed and broken by episodes of violent boiling.

This setting is repeated in many areas within the Mojave study region. Formation of several Miocene to Pliocene basins was accompanied by intrusion and associated volcanic activity of rhyolitic composition within the project area. Mineralization related to this rhyolitic activity occurs in the Mojave, Rand, Loraine, Hart and Hackberry districts. A major disseminated hotspring deposit is believed to exist in this setting in the Hart district.

We suggest that exposed Tertiary sediments, particularly where they are intruded by rhyolitic volcanic rocks be systematically explored for possible disseminated type mineralization. Areas of silicification, argillic alteration and sporatic gold mineralization should be paid special attention. A method in which to facilitate reconnaissance of the broad prospective areas would be to utilize light plane overviews looking for obvious altered areas. These areas could then be field checked and sampled on a priority basis.

a. Lanfair Basin.

Late Miocene silicic volcanic rocks and interbedded lacustrine sediments are exposed around the margins of this topographic feature. The Hart and Hackberry districts are hosted by these rocks. What appears to be a classic hotsprings related disseminated deposit has been recently staked in the Hart district. Widespread zones of silicification and argillic alteration affect many areas of the volcanics and sediments. Arsenic, antimony and mercury anomalies (see section on Regional Geochemistry) also occur in these rocks. Exposed Tertiary volcanics and sediments in this basin should be immediately examined, preferably from the air first. Competition is beginning to rush to the area, and in a short while remaining opportunities will probably be lost.

b. Rand district.

Tertiary sediments exposed within and adjacent to the northern edge of the district display silicification, argillization and sporatic disseminated gold mineralization. The extensive field of interbedded Tertiary sediments and volcanic rocks provides a favorable terrian that has probably received little modern prospecting. This terrain should be reconoitered for areas of argillization and silicification paying particular attention to areas near Tertiary plugs and rhyolitic rocks.

c. Jawbone Canyon district.

Large zones of hydrothermally altered rhyolite have been mined in this district for clay. Mercury and some gold also occurs associated with altered rhyolitic volcanic rocks and dikes. Argillized zones should be examined for any accompanying hydrothermal silicification, stockwork veining and associated gold-mercury mineralization.

d. Loraine district.

Large areas of intrusive rhyolite cut volcanic rocks and pre-Tertiary basement north and west of Emerald Peak. The volcanic rocks also contain much interbedded sediments to the south and east. Gold mineralization in this district is associated with the intrusive rhyolitic activity. Much of this area is rugged, fairly remote, and has probably received little recent exploration attention. Mines like the Zenda, where gold and silver mineralization was mined across a 30-50 ft. wide zone along the contact of a rhyolite porphyry dike and quartz monzonite, suggest that the district possesses good potential for possible low-grade stockwork and disseminated type ore.

e. Mojave.

The impressive amount of epithermal gold-silver mineralization in the Mojave district causes one to speculate about potential disseminated mineralization in tuffaceous sediments in the pediment areas surrounding the major vein producers. While much of the favorable part of the section may be eroded away, the possibility remains good that large amounts of disseminated mineralization exist at shallow depth in pediment areas surrounding the mineralized buttes. It is doubtful that this district has ever been explored from this viewpoint. Any successful program for this kind of target will have to utilize "state-of-the-art" methods for locating blind targets. A potential method we would recommend is soil-gas surveys (see district description). We suggest that if a land position can be secured in this district, such a survey be undertaken in the pediment areas adjoining claim blocks.

Another site of high potential in the Mojave district is an area of jasperoid mentioned by Perez (1978) on the southwest side of Soledad Mountain. Perez notes that jasperoids in this area occur closely related to the brecciated contact of a hypabyssal intrusive body. This intrusive contact should be examined for potential stockwork or disseminated gold mineralization.

f. Other favorable areas.

In addition to the previously mentioned priority areas containing geologic settings favorable for hosting hotspring related disseminated deposits, several additional areas also warrant investigation.

HSSR samples in the southern Chuckwalla Mountains and Black Hills area display numerous gold and arsenic anomalies. Many of these anomalies occur in areas within the Palo Verde volcanics where gold mining activity is not known. The Palo Verde volcanic field is composed of silicic tuffs and flows that are intruded by numerous rhyolitic intrusions. Abundant chalcedony nodules occur in gravels being shed from these volcanic rocks in the southern Chuckwalla Mountains and indicate that areas of hotspring silicification may locally occur within them. We recommend this area be reconoitered for potential hotspring deposit environments.

Mercury and apparently some gold has been mined from altered Miocene rhyolite bodies intruding Cretaceous granitic rocks in the Tehachapi district. Some of the rocks are highly kaolinized in the vicinity of the intrusions. These geologic factors warrant examination.

Exposures of opaline silica and silicified tuff occur in a chain of low hills that trend eastward about three miles north of Shadow Mountain (Secs. 31, 32, T18N, R11E). These occurrences may signal hotspring related deposits. Besides these silicified volcanics and sediments much of the Shadow Mountains to the west are underlain by similar lithologies. Two HSSR geochem samples display anomalous arsenic and mercury in the area and gold has been mined at Shadow Mountain.

Rhyolitic intrusives related to the Opal Mountain volcanics intrude an extensive sequence of Tertiary sediments in the Gravel Hills. Dikes of similar rhyolite are related to gold mineralization in the adjacent Fremont Peak district to the west. Two NURE gold anomalies occur in sediments that appear to drain this area. As gold mineralization is not known in these interbedded sediments and volcanic rocks, they may not yet have been looked at in terms of this type of target and may be a sleeper area.

Interbedded Tertiary sediments and volcanic rocks in the Neenatch basin contain no known metal occurrences. These rocks, however, are believed to be a faulted off portion of the Pinnacles volcanic field that has been offset some 300 km along the San Andreas fault. Of significance is the little known fact that low-grade disseminated gold mineralization exists in altered rhyolites in the Pinnacles volcanics (unfortunately in a withdrawn area). The Neenatch volcanics would thus appear to warrant some examination as well.

3. Other thrust faults.

In addition to the high priority given to the Vincent-Chocolate Mountains thrust zone, several other thrust complexes appear to warrant examination. The general model proposed for the Vincent thrust is believed to apply to these areas as well.

a. Doble (Black Hawk) thrust:

An extensive Cenozoic fault exposed along most of the northern San Bernardino Mountains is described as a thrust or low-angle reverse fault. Significant low-grade gold mineralization occurs in altered Paleozoic carbonate rocks in the upperplate of this thrust zone. An impressive number of gold mines and HSSR geochem anomalies occur in close proximity to this and a subsidiary(?) thrust zone to the south. Hydrothermally altered carbonate rocks in this area should be thoroughly examined. In fact, this area would be ideally suited for an extensive stream sediment sampling program to delineate favorable target zones along these thrust sheets. For example, a large HSSR gold anomaly occurs in an area of known mines in the vicinity north of Gold Mountain along the southern (subsidiary) thrust. Numerous individual mines in the Black Hawk, Holcomb Valley and Baldwin Lake districts (i.e., Cliff, Gold Button, Green Lead, Ozier, Jeff Davis, Rose and Doble mines; see district descriptions herein) display potential for stockwork or disseminated type mineralization and should be given proper field evalution. Some, but not all of these deposits appear to be related to the thrust faulting in this area.

b. Clark Mountains thrust zone.

While the entire Clark Mountains thrust zone may offer potential, we have targeted the segment exposed at the Morning Star mine. Mine descriptions indicate that gold-bearing quartz vein stockworks occur in broken zones in the upperplate of the Morning Star thrust. These zones were reported to have been extensively explored but with little ore actually shipped due to the overall low-grade. There would appear to be an excellent opportunity for a large bulk-tonnage deposit in this zone. We would recommend immediate examination of this property.

c. Miscellaneous thrust areas.

Gold mineralization appears to be associated with thrust faulting in the Old Dad, the Old Woman-Piute, the Mule, and the Arica Mountains, and the complex McCoy suture zone in the Big Maria and Little Maria Mountains. Individual mines associated with thrust faults in these areas should be given examination to ascertain whether any possess adequate structural preparation and degree of mineralization for a client target.

4. Early Mesozoic Volcanic-Pluton Porphyry Copper-Gold:

The type example of this setting occurs in the Ord Mtn. district 20 miles southeast of Barstow. Two areas along the prominent Ord Mtn. high-angle fault zone display characteristics typical of porphyry Cu-Au systems in analogous terrains in northern Washington and British Columbia.

The two areas are the Moly Prospect and Ord Mtn. Mine Group. They are both associated with late-stage keratophyre intrusive bodies emplaced along the Ord Mtn. fault zone. Gold in the 0.1 to 0.3 oz range (plus .2-1% Cu) occurs in a multitude of intersecting fractures and shear zones. Mineralization accompanies widespread albitic alteration within volcanic host rocks and shallow intrusions. The setting appears highly opportune for discovery of bulk, low-grade gold ore.

In addition to these specific target areas, client should keep this environment in mind in other localities where the appropriate rocks are exposed. The analogies of the Mojave Triassic setting with productive gold terrains elsewhere may have escaped other prospectors, so the chance to capitalize on a novel porphyry-gold environment may be yours.

5. <u>Metamorphic Core Complex Detachment Zone Targets</u>:

Although the precious metals occurrences margining MCC are numerous, our Phase 1 research has highlighted only four priority areas. As data on other occurrences are slim, we can only recommend the setting in general and suggest that further invetigations into unpublished USBM data or reconnaissance field checks be made. The four most favorable areas include:

a. West side of Sacramento MCC: A cluster of small precious metals occurrences is found in complex, detachment fault terrain west of the Sacramento Mtns. The brief CRIB descriptions suggest individual quartz veins and mineralized, silicified shear zones, but reported gold assays range from approximately 0.1 to 0.6 oz Au. The setting is favorable for bulk mineralization associated with the highly fractured and brecciated detachment or listric zones; therefore, these occurrences should be checked when possible.

b. Chambers Well-Savahia Peak Area-SW Whipple MCC: Numerous gold occurrences occur in a 5-10 mile-wide, intense dike swarm. Where dike zone intersects Whipple-Buckskin detachment surface, other occurrences are noted. The setting is thought especially favorable for detachment zone mineralization.

Copper Basin-Whipple MCC: Data on this district is included with Rehrig's metamorphic core complex report. Specifically, gold occurs with copper in several major listric shear zones which measure several thousand feet in strike length, and 50 to 100 ft. in width. Drilling done to delineate 20-50 m.t. of low-grade copper reserves indicates that the gold-bearing zones widen as they merge with a lower detachment zone at several hundred foot depths. The vein zones are extremely silicified and ore in one (Hines zone) is reported to run about 0.1 oz Au. During copper exploration, assaying for gold was only spot checked on an erratic basis. We feel that follow-up work might delineate 1 m.t. of 0.1 oz material from the high-grade shear zones and the areas of intersection with the underlying detachment surface.

c. Bendigo District-Riverside Mtns: Mineralization consisting of gold-copper in gangue of barite, carbonate, quartz and iron-manganese oxides occurs at the Gold Rice and Prospector mines along a possible Tertiary detachment zone and along a Laramide(?) thrust zone at the larger Mountaineer, Morning Star and Gold Dollar mines. Production has been small from these properties, but gold grades are high (to several ounces). Both structural zones should be checked for more continuous or dispersed low-grade mineralization.

6. Miscellaneous Mines:

While examining the mining literature, numerous individual mines occurring outside of areas already mentioned in this section drew our attention for various reasons (i.e., past production, structural preparation, stockwork veining, alteration, etc.). While these mines are briefly noted under "Mines of Interest" in the District Focus section of this report, several will be repeated at this time. It is recommended that most of the mines described in the "Mines of Interest" sections be given some actual ground study in any future reconnaissance programs taken into these areas.

(The following list is in no particular order of priority.)

a. Lucy Gray Mine (see Clark Mountain district). Mine is actually located just outside of the area of interest. Workings explore breccia pipe in Precambrian gneiss cemented by gold-bearing quartz. Past production of about $50,000. May be potential bulk tonnage target such as the nearby Colosseum mine (Amselco and Draco, J.V.).

b. Hercules (see Hikorum district). Copper-stained, fine-grained quartz porphyry dikes cut granite said to carry $6 to $8 (old prices) per ton gold. Area developed by shallow shafts and several hundred feet of open cuts.

c. Golden Bee (see Hexie Mountains district). Workings explore major north-trending fault zone cutting gneiss. Fault is marked by crushed zone as much as 100 ft. wide. Ore occurs in veins and stockworks(?) permeating the crushed and iron-stained fault zone.

d. Red Cloud mine (see Chuckwalla district). Mineralized quartz vein as much as 15 ft. wide is well exposed along an outcrop length of 4,500 ft.

The vein lies within a crushed zone in which the hanging wall is altered and silicified through a zone as much as 200 ft. wide. This altered zone forms a bold buff-colored, iron-stained outcrop. Past production was at least 5,000 oz. of gold. If hanging wall zone hosts low-grade mineralization, a large deposit could exist here.

e. Tumco area (see Cargo Muchacho district). Tumco area was major past producer that was withdrawn from mining in years past. Area was reopened for mineral entry only last year. Resulting land rush created a legal entanglement which is being litigated. Client may want to keep abreast of situation for potential lease option from the resultant claim winner. Much competition for this land from other majors, however, will likely be encountered.

f. Sky Blue No. 3 (see Goldstone district). Irregular silicified veins occurring in fault zones in shattered eugeosynclinal rocks similar to those found in El Paso Mountains. Area worked by shallow open cuts.

g. Atwood clay deposit (see Oro Grande district). Felsic lavas and tuffs of Sidewinder volcanics display arcuate zone of strong hydrothermal alteration consisting of white kaolinitic clay, alunite and alunitic clay 50 to 100 ft. thick. This zone is in turn overlain by highly silicified volcanics at least 100 to 200 ft. thick. This was mined in the past for clay and no gold occurrences are reported. It sounds like a perfect hot-spring environment for a disseminated deposit, however, and should be given a close examination.

h. Pine Tree mine (see Tehachapi district). Over $250,000 in past production from shallow dipping (20° to 40°) quartz veins in granitic rocks.

The vein lies within a crushed zone in which the hanging wall is altered and silicified through a zone as much as 200 ft. wide. This altered zone forms a bold buff-colored, iron-stained outcrop. Past production was at least 5,000 oz. of gold. If hanging wall zone hosts low-grade mineralization, a large deposit could exist here.

e. Tumco area (see Cargo Muchacho district). Tumco area was major past producer that was withdrawn from mining in years past. Area was re-opened for mineral entry only last year. Resulting land rush created a legal entanglement which is being litigated. Client may want to keep abreast of situation for potential lease option from the resultant claim winner. Much competition for this land from other majors, however, will likely be encountered.

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h. Pine Tree mine (see Tehachapi district). Over $250,000 in past production from shallow dipping (20° to 40°) quartz veins in granitic rocks.

Maximum width of quartz veins is about 3 ft., however, hanging wall and footwall of most veins also display brecciation. Much underground workings explored these "flat" fault surfaces. May have potential for strip mineable stockwork ore in brecciated zones above and below main quartz seams.

i. Yellow Treasure (see Rademacher district). Shear zone up to 30 ft. wide, hosts numerous, short, gold-bearing quartz pods. Locally, ore zones are thin and closely spaced. Workings incude shaft and numerous open cuts. Shear zone is about one mile long.

j. Iron Chief (see Eagle Mountains district). Mine explored contact zone between quartz monzonite and calcitic dolomite. Oxidized zone 6 ft. wide (average) contained ore that averaged nearly 0.50 opt Au down to 100 ft. depth. At least 20,000 tons of production prior to 1924. Area should be checked to see if lower grade material might extend much farther outward into the hydrothermally affected carbonate rocks.

k. Desert Queen (see Gold Park district). Contact zone between two granitic bodies contains numerous dikes and gold-bearing quartz veins and pockets. Past production of at least 3,700 oz. of gold. If contact zone is sufficiently brecciated, some potential may exist in this area for stockwork and disseminated mineralization.

7. <u>NURE HSSR Geochem Anomalies:</u>

We have described a large number of interesting geochemical anomalies that are displayed on Overlay 6. While the quality of all the NURE geochem is questionable, there appears to be good correlation of many of the anomalous samples with known gold occurrences. This implies that gold and pathfinder anomalies that cannot be readily accounted for may represent bona fide target areas, worthy of further reconnaissance. Some of these anomalies occur in areas discussed above.

MOJAVE PROJECT

Volume II

APPENDICES

APPENDIX 1

References used in compiling CDCA computerized base used for Mojave Desert Project

REFERENCES

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APPENDIX 2

GEOREF Listings for Mojave Desert Project

1137246 82-56031

The Mojave Desert
Rowlands, P.; Johnson, H.; Ritter, E.; Endo, A.

Reference handbook on the deserts of North America
Bender, G. L.(EDITOR)
Publ: Greenwood Press
103-162p., 1982
ISBN: 0-313-21307-0 320 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
illus., 13 tables
Descriptors: *California; *geomorphology ; eolian features ; deserts; San Bernardino County; Kern County; United States; Mojave Desert; tectonics; climate; ecology; petrology; stratigraphy
Section Headings: 23 .(SURFICIAL GEOLOGY, GEOMORPHOLOGY)

1126719 82-44614

Field trip number 7; Comparison of Mesozoic tectonics with mid-Tertiary detachment faulting in the Colorado River area, California, Arizona, and Nevada
Frost, E. G.(leader); Cameron, T. E.(leader); Martin, D. L.(leader)
San Diego State Univ., Dep. Geol. Sci., San Diego, CA, USA

Geologic excursions in the California desert
Cooper, J. D.(EDITOR)
Publ: Geol. Soc. Am.
111-159p., 1982
153 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
illus., sketch maps
Latitude: N340000; N360000 Longitude: W1140000; W1160000
Descriptors: *California; *Nevada; *Arizona; *faults ; structural geology; displacements ; tectonics; normal faults; Yuma County; Mojave County; Clark County; San Bernardino County; United States; Mesozoic; Phanerozoic; Tertiary; Cenozoic; Colorado River; compression tectonics; guidebook; road log; extension; decollement
Section Headings: 16 .(STRUCTURAL GEOLOGY)

Integrated terrain mapping

Integrated terrain mapping
Hutchinson, C. F.(investigator)
U. S. Geol. Surv., Prof. Pap. 1100, 306p., 1978
CODEN: XGPPA9
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL Bibliographic Level: ANALYTIC
Languages: English
Descriptors: *California ; environmental geology ; land use; remote sensing; satellite methods; geophysical methods ; classification; maps; United States; Mojave Desert; cartography; Landsat
Section Headings: 22 .(ENGINEERING & ENVIRONMENTAL GEOLOGY)

911815 78-42542

Tectonic geomorphology of the Mojave Desert, California
Bull, W. B.
Univ. Ariz., Dep. Geosci., Tucson, Ariz., USA
The Geological Association of Canada, The Mineralogical Association of Canada, The Geological Society of America (91st annual meeting); 1978 joint annual meeting, Toronto, Ont., Canada, Oct. 23-26, 1978
Geol. Soc. Am., Abstr. Programs 10: 7, 374/4p., 1978
CODEN: GAAPBC
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; CONFERENCE PUBLICATION Bibliographic Level: ANALYTIC
Languages: English
Latitude: N343000; N353000 Longitude: W1150000; W1183000
Descriptors: *California; *geomorphology ; structural geology; landform evolution ; neotectonics; uplifts; United States; Southern California; Mojave Desert; Los Angeles County; Kern County; San Bernardino County; Quaternary; Cenozoic; vertical tectonics; structural controls; faults
Section Headings: 16 .(STRUCTURAL GEOLOGY)

908038 78-39462

Slope stability and related geology, Kramer sodium borate ore body, Boron, California
Siefke, J. W.
U. S. Borax and Chem. Corp., Boron, Calif., USA
19th U. S. symposium on rock mechanics, Stateline, Nev., United States, May, 1-3, 1978
Symp. Rock Mech., Proc. 19, Vol.1, 301-306p., 1978
CODEN: PSRMA6 11 REFS.
Subfile: B
Country of Publ.: Varies
Doc Type: SERIAL; CONFERENCE PUBLICATION Bibliographic Level: ANALYTIC
Languages: English
illus., table, geol. sketch map
Latitude: N345000; N351500 Longitude: W1172500; W1175000
Descriptors: *California; *rock mechanics; *well-logging ; engineering geology; economic geology; excavations; dipmeter logging ; slope stability; boron; down hole; Kern County; San Bernardino County; United States; Mojave Desert ; Kramer ore body; borates; ore deposits; ore bodies; failure; open-pit mining; sodium borate
Section Headings: 22 .(ENGINEERING & ENVIRONMENTAL GEOLOGY)

893438 78-24700

Preliminary study of the uranium favorability of Mesozoic intrusive and Tertiary volcanic and sedimentary rocks of the central Mojave Desert, Kern and San Bernardino counties, California
Leedom, S. H.; Kiloh, K. D.
86p., 1978
40 REFS.
Subfile: B
Doc Type: REPORT Bibliographic Level: MONOGRAPHIC
Languages: English
Report No.: GJBX- 24(78)
Availability: U. S. Dep. Energy, Grand Junction Off., Grand Junction, Colo., United States
Note: With microfiche card of geologic map and section of study area, illus., tables, sketch maps
Latitude: N344500; N353000 Longitude: W1160000; W1180000
Descriptors: *California ; economic geology ; uranium; United States; Kern County; San Bernadino County; Mojave Desert; volcanic rocks; sedimentary rocks; Tertiary; Cenozoic; Mesozoic; Phanerozoic; ore bodies; ore deposits
Section Headings: 27 .(ECONOMIC GEOLOGY, METALS)

891658 78-23149

Active structures in the western Mojave Desert, California
Burke, D. B.; Hedel, C. W.
U. S. Geol. Surv., Menlo Park, Calif., USA
The Geological Society of America, Cordilleran Section, 74th annual meeting, Tempe, Ariz., United States, March 29-31, 1978
Geol. Soc. Am., Abstr. Programs 10: 3, 98p., 1978
CODEN: GAAPBC
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL Bibliographic Level: ANALYTIC
Languages: English
Latitude: N332000; N360000 Longitude: W1140000; W1184500
Descriptors: *California ; structural geology ; tectonics; San Bernardino County; Riverside County; Kern County; Los Angeles County; United States; Mojave Desert; thrust faults ; faults; uplifts; San Gabriel Mountains; Antelope Valley; Sand Hills Anticline; Quaternary; Cenozoic; active faults
Section Headings: 16 .(STRUCTURAL GEOLOGY)

888060 78-17019

Gravity-sliding in the Newberry Mountains, California, and its relationship to the late Cenozoic evolution of the Mojave structural block
Dokka, R. K.
Univ. South Calif., Dep. Geol. Sci., Los Angeles, Calif., USA
The Geological Society of America, Cordilleran Section, 73rd annual meeting, Sacramento, Calif., United States, April 5-7, 1977
Geol. Soc. Am., Abstr. Programs 9: 4, 412p., 1977
CODEN: GAAPBC
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; CONFERENCE PUBLICATION Bibliographic Level: ANALYTIC
Languages: English
Descriptors: *California; *faults ; structural geology; displacements ; San Bernardino County; tectonics; gravity faults; United States; evolution; Newberry Mountains; folds; shear zones; basement; strike-slip faults; upper Cenozoic; Cenozoic; Mojave structural block; subduction; sedimentation; volcanic rocks; block structures
Section Headings: 16 .(STRUCTURAL GEOLOGY)

864709 77-46031

Tertiary sedimentary basins of the Transverse Ranges and adjacent areas, southern California
Woodburne, M. O.
Univ. Calif., Dep. Earth Sci., Riverside, Calif., USA
The Geological Society of America, Cordilleran Section, 71st annual meeting, Los Angeles, Calif., United States, March 25-27, 1975
Geol. Soc. Am., Abstr. Programs 7: 3, 389-390p., 1975
CODEN: GAAPBC
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; CONFERENCE PUBLICATION Bibliographic Level: ANALYTIC
Languages: English
Latitude: N323000; N380000 Longitude: W1140000; W1230000
Descriptors: *tectonics; *Tertiary; *California ; structure ; United States; structural geology ; faults; sedimentary basins; sedimentation; Transverse Ranges; Ridge Basin; Caliente Range; Orocopia Mountains; Mojave Desert; San Andreas Fault
Section Headings: 16 .(STRUCTURAL GEOLOGY)

859742 77-37854

Southern Turtle Mountains; a possible area of early Basin and Range structure in the southeastern Mojave Desert
Hatheway, A. W.; Kuniyoshi, S.
Fugro Inc., Long Beach, Calif., USA
The Geological Society of America, Cordilleran Section, 71st annual meeting, Los Angeles, Calif., United States, March 25-27, 1975
Geol. Soc. Am., Abstr. Programs 7: 3, 322-323p., 1975
CODEN: GAAPBC
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; CONFERENCE PUBLICATION Bibliographic Level: ANALYTIC
Languages: English
Descriptors: *California; *tectonics; *Cretaceous; *Cenozoic ; structural geology; structure; United States ; Mojave Desert; Turtle Mountains; basin and range structure; structural complexes; neotectonics; Miocene; Pliocene; Quaternary
Section Headings: 16 .(STRUCTURAL GEOLOGY)

851256 77-30116

Geology and structural evolution of Old Dad Mountain, Mojave Desert, California
Dunne, G. C.
Calif. State Univ., Dep. Geosci., Northridge, Calif., USA
Geol. Soc. Am., Bull. 88: 6, 737-748p., 1977
CODEN: BUGMAF 24 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL Bibliographic Level: ANALYTIC
Languages: English
illus., table, sects., geol. sketch map
Latitude: N350000; N353000 Longitude: W1150000; W1170000
Descriptors: *California; *tectonics; *Mesozoic ; structural geology; United States ; San Bernardino County; south; Mojave Desert; Old Dad Mountain; structural complexes; evolution; areal geology; shear zones; faults; thrust; normal; orogenic belts; Tertiary
Section Headings: 16 .(STRUCTURAL GEOLOGY)

848884 77-31341

Soda Lake and Silver Lake valleys
Thompson, D. G.

Playas and dried lakes
Neal, J. T.(EDITOR)

Benchmark papers in geology
Publ: Dowden, Hutchinson, & Ross, Inc.
20, 139-149p., 1975
32 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
Note: With discussion; excerpt, Reprint from U. S. Geol. Surv. Water-Supply Pap., No. 578,, illus., sect.
Descriptors: *geomorphology; *California ; lacustrine features ; playas; valleys; discharge; ground water; United States; Soda Lake; Silver Lake; Mojave Desert
Section Headings: 23 .(SURFICIAL GEOLOGY, GEOMORPHOLOGY)

827265 77-06507

Surface roughness information from L-band SLAR
Dailey, M. I.
Calif. Inst. Technol., Pasadena, Calif., USA
Geol. Soc. Am., Abstr. Programs 8: 3: Cordilleran Section, 72nd annual meeting, 366p., 1976
CODEN: GAAPBC
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL Bibliographic Level: ANALYTIC
Languages: English
Descriptors: *geophysical methods; *United States ; acoustical methods; geophysical surveys ; Inyo County; interpretation; applications; relief; roughness; sand; grain size; faults; radar; side-scanning; maps; California; Death Valley; Mojave Desert; Nevada; Lake Mead ; remote sensing; southwest
Section Headings: 20 .(GEOPHYSICS, APPLIED)

822482 77-03281

Origin, nature and significance of sediment mounds on Danby Dry Lake, Mojave Desert, California
Tamura, A. Y.; Stone, R. O.
Global Marine, Inc., Los Angeles, Calif., USA; Univ. South. Calif., United States
Geol. Soc. Am., Abstr. Programs 7: 7, 1290-1291p., 1975
CODEN: GAAPBC
Subfile: B
Doc Type: SERIAL Bibliographic Level: ANALYTIC
Languages: English
Descriptors: *California; *geomorphology ; landform description ; mounds; buttes; Mojave Desert; Danby Dry Lake; sediments; playas; mechanism; genesis; ground water ; erosion; tectonics; United States
Section Headings: 23 .(SURFICIAL GEOLOGY, GEOMORPHOLOGY)

817915 76-44161

Variations in Sr, Rb, K, Na and initial .87.Sr/.86.Sr in Mesozoic granitic rocks in the vicinity of the Garlock Fault zone, California
Kistler, R. W.; Peterman, Z. E.
U. S. Geol. Surv., Menlo Park, Calif., USA
Geol. Soc. Am., Abstr. Programs 7: 7, 1147-1148p., 1975
CODEN: GAAPBC
Subfile: B
Doc Type: SERIAL Bibliographic Level: ANALYTIC
Languages: English
Descriptors: *California; *isotopes; *strontium; *igneous rocks; *Mesozoic; *tectonics ; geochemistry; evolution; United States ; rubidium; potassium; sodium; Sierra Nevada ; Mojave Desert; chemical composition; granitic; applications; fault zones; faults; block; rifting; igneous activity; Sr-87/Sr-86; ratios; abundance; Mojave Dessert
Section Headings: 02 .(GEOCHEMISTRY)

817631 76-43877

Tectonic geomorphology of arid regions
Bull, W. B.
Univ. Ariz., Tucson, Ariz., USA
Geol. Soc. Am., Abstr. Programs 7: 7, 1013p., 1975
CODEN: GAAPBC
Subfile: B
Doc Type: SERIAL Bibliographic Level: ANALYTIC
Languages: English
Descriptors: *tectonics; *geomorphology; *California; *Mexico ; vertical tectonics; landform evolution ; uplifts; effects; valleys; streams; morphostructures; slopes; channels; erosion; alluviation; climate; arid; Mojave Desert; Sonora Desert
Section Headings: 23 .(SURFICIAL GEOLOGY, GEOMORPHOLOGY)

809116 76-35362

Gravity investigation in the southeastern Mojave Desert, California
Rotstein, Y.; Combs, J.; Biehler, S.
Univ. Tex., Program Geosci., Richardson, Tex., USA; Univ. Calif., United States
Geol. Soc. Am., Bull. 87: 7, 981-993p., 1976
CODEN: BUGMAF
Subfile: B
Doc Type: SERIAL Bibliographic Level: ANALYTIC
Languages: English
Univ. Tex., Program Geosci.; Contrib. No. 282, illus., tables, sketch maps
Descriptors: *California; *geophysical surveys; *tectonics ; gravity surveys; structure ; Riverside County; south; Mojave Desert; Blythe; Desert Center; United States; ground; Bouguer anomalies; maps; data; basement; faults; sedimentary basins; anomalies
Section Headings: 20 .(GEOPHYSICS, APPLIED)

803938 76-30184

Aseismic uplift in southern California
Castle, R. O.; Church, J. P.; Elliott, M. R.
U. S. Geol. Surv., Menlo Park, Calif., USA
Science (AAAS) 192: 4236, 251-253p., 1976
CODEN: SCIEAS
Subfile: B
Doc Type: SERIAL Bibliographic Level: ANALYTIC
Languages: English
sketch maps
Descriptors: *California; *tectonics ; structural geology; vertical tectonics ; Los Angeles County; Orange County; Riverside County; San Bernardino County; uplifts; south; San Andreas Fault; Garlock Fault; Mojave Desert; aseismic; detection; crust; geodesy; levelling; data; 1934-1974; United States
Section Headings: 16 .(STRUCTURAL GEOLOGY)

803660 76-29906

Theory of plasticity applied to faulting, Mojave Desert, southern California
Cummings, D.
Occident. Coll., Dep. Geol., Los Ang., Calif., USA
Geol. Soc. Am., Bull. 87: 5, 720-724p., 1976
CODEN: BUGMAF
Subfile: B
Doc Type: SERIAL Bibliographic Level: ANALYTIC
Languages: English
illus., sketch maps
Descriptors: *plate tectonics; *faults; *California ; geometry; mechanics; structural geology ; Kern County; San Bernardino County; patterns; models; stress; plasticity; south; Mojave Desert; theoretical studies; two-dimensional; distribution; United States
Section Headings: 16 .(STRUCTURAL GEOLOGY)

764932 75-31679

Tectonics of the western Mojave Desert near the San Andreas Fault
Dibblee, Thomas W., Jr.
U.S. Geol. Surv., Menlo Park, Calif., USA
Calif. Div. Mines Geol., Spec. Rep. 118: San Andreas Fault in southern California; a guide to San Andreas Fault from Mexico to Carrizo Plain, 155-161p., 1975
CODEN: CCGRAH
Subfile: B
Doc Type: SERIAL Bibliographic Level: ANALYTIC
Languages: English
geol. sketch maps
Descriptors: *tectonics; *California; *Cenozoic ; vertical tectonics; United States; areal geology ; Punchbowl Formation; Crowder Formation; uplifts; compression; basement; relation; faults; Mojave Desert; Quail Lake; Cajon Pass; San Andreas Fault; stratigraphy; lithostratigraphy; structural geology; basins; Tertiary; Quaternary; south
Section Headings: 16 .(STRUCTURAL GEOLOGY)

754517 75-20288

Extension of the Cordilleran miogeosynclinal belt to the San Andreas Fault, southern California
Stewart, J. H.; Poole, Forrest G.
Geol. Soc. Am., Bull. Vol. 86, No. 2, p. 205-212, illus. (incl. geol. sketch map), 1975
CODEN: BUGMAF
Subfile: B
Doc Type: SERIAL
Languages: English
Correlation (Precambrian-Paleozoic), late Paleozoic-Mesozoic truncation of Cordilleran geosyncline
Descriptors: *California; *Precambrian; *Geosynclines; *Paleozoic; *Tectonics ; Areal geology; United States; Distribution; Evolution ; Stratigraphy; structural geology; petrology; San Bernardino County; San Bernardino Mountains; Mojave Desert; south; metamorphic rocks; correlation; Cordilleran; truncation; faults; rifting; Mesozoic; San Andreas Fault; sedimentary rocks; marine; displacements; upper Paleozoic
Section Headings: 13 .(AREAL GEOLOGY, GENERAL)

751632 75-17403

Continuing crustal deformation in the western Mojave Desert [abstr.]
Church, Jack P.; Castle, Robert O.; Clark, Malcolm M.; Morton, Douglas M.
Geol. Soc. Am., Abstr. Vol. 6, No. 7, p. 687-688, 1974
CODEN: GAAPBC
Subfile: B
Doc Type: SERIAL
Languages: English
Descriptors: *California; *Faults; *Crust ; Structural geology; Displacements; United States ; Quaternary; Mojave Desert; west; Fremont Valley; Normal; slip; direction; activation; measurement; rates; mechanism; Helendale Fault ; Lenwood-Lockhart Fault; tectonics; deformation; San Bernardino County; Los Angeles County; Kern County
Section Headings: 16 .(STRUCTURAL GEOLOGY)

747586 75-13356

The Compression Zone Across Southern California [abstr.]
Pease, Robert W.

in Thirty-Sixth Annual Meeting,
Assoc. Pac. Coast Geogr., Yearb. Vol. 36, No. 167-168, 1974
CODEN: YAPGAJ
Subfile: B
Doc Type: SERIAL
Languages: English
Descriptors: *California; *Tectonics ; Structural geology; Structure ; south; Los Angeles Basin; Transverse Ranges; Mojave Desert; Sylmar Fault; Lineaments; faults; compression; earthquakes; remote sensing; satellite; ERTS-1; United States
Section Headings: 16 .(STRUCTURAL GEOLOGY)

736561 75-01942

Report of the sub-commission for North America
Meade, Buford K.

in Reports on Geodetic Measurements of Crustal Movement, 1906-71, 9 p., sketch maps,
Natl. Oceanic Atmos. Admin.-Natl. Ocean Surv.-Natl. Geod. Surv. Rockville, Md., 1973
Subfile: B
Languages: English
Reprint of the Report of the sub-commission for North America; Third Symposium on Recent Crustal Movements, Leningrad, USSR, 1968,
Descriptors: *Geodesy; *United States ; Surveys; Engineering geology ; Crust; movement; faults; earthquakes ; Alaska; California; Eel River; San Francisco County; San Francisco; Los Angeles County; Los Angeles; San Francisco Bay; San Benito County; Hollister; Cholame; Kern County; Taft; Mojave; Imperial Valley; Gorman; Nevada; Dixie Valley; Utah; Salt Lake area
Section Headings: 22 .(ENGINEERING & ENVIRONMENTAL GEOLOGY)

736552 75-01933

Current and recent movement on the San Andreas Fault
Meade, Buford K.; Small, James B.

in Reports on Geodetic Measurements of Crustal Movement, 1906-71, 7 p., illus. (incl. sketch maps),
Natl. Oceanic Atmos. Admin.-Natl. Ocean Surv.-Natl. Geod. Surv. Rockville, Md., 1973
Subfile: B
Languages: English
Reprint from California Division of Mines and Geology, Bulletin 190, 1966,
Descriptors: *California; *Geodesy ; Engineering geology; Surveys ; earthquakes; displacements; San Andreas Fault; Marin County; Point Reyes; Sonoma County; Petaluma; Alameda County; Hayward; Monterey Bay; San Benito County; Hollister; Salinas River Valley; San Luis Obispo County; San Luis Obispo; Kings County; Avenal; Cajon Pass; Imperial Valley; Imperial County; El Centro; Kern County; Taft; Mojave; Faults; crust; movement; rates; United States
Section Headings: 22 .(ENGINEERING & ENVIRONMENTAL GEOLOGY)

735072 75-00453

Model for the Late Cenozoic Tectonic History of the Mojave Desert, California, and for Its Relation to Adjacent Regions
Garfunkel, Zvi.
Geol. Soc. Am., Bull. Vol. 85, No. 12, p. 1931-1944, illus. (incl. geol. sketch map), 1974
CODEN: BUGMAF
Subfile: B
Doc Type: SERIAL
Languages: English
Cal. Tech., Div. Geol. Planet. Sci., Contrib. No. 2166, Right-slip faults, model
Descriptors: *Faults; *California; *Tectonics; *Tectonophysics ; Displacements; plate tectonics; Evolution ; Structural geology ; Right-lateral; models; upper Cenozoic; Mojave Desert; block; plates; movement; United States; boundary; San Bernardino County
Section Headings: 16 .(STRUCTURAL GEOLOGY)

728633 74-33774

Geology and mineral resources of California
California State Division of Mines.
Calif. Div. Mines Geol., Miner. Inform. Serv. Vol. 10, No. 8, p. 1-20, 1957
CODEN: CDMIAR
Subfile: B
Doc Type: SERIAL
Languages: English
Descriptors: *California; *Mineral resources ; Economic geology; United States ; West Shast District; Mojave Desert ; San Francisco; ore deposits; mercury; placers; copper; zinc; evaporites; production; legislation; 1956
Section Headings: 26 .(ECONOMIC GEOLOGY, GENERAL & MINING)

727469 74-32610

Geophysical Investigations in the Eastern Mojave Desert, California [abstr.]
Rotstein, Yair; Combs, Jim; Biehler, Shawn.
Eos (Am. Geophys. Union, Trans.) Vol. 55, No. 4, p. 448, 1974
CODEN: EOSTAJ
Subfile: B
Doc Type: SERIAL
Languages: English
Descriptors: *California; *Geophysical surveys ; Surveys ; Mojave Desert; east; Transverse Mountains; Chuckwalla Valley; Palen Valley; Palo Verde Valley; United States; gravity surveys; seismic surveys; electrical surveys; magnetic surveys; ground; tectonics; anomalies; faults; lineaments
Section Headings: 18 .(GEOPHYSICS, SOLID EARTH)

724157 74-29298

Geology of the Mojave Desert
Dibblee, T. W., Jr.; Hewett, D. F.
Calif. Div. Mines Geol., Miner. Inform. Serv. Vol. 23, No. 9, p. 180-185, illus. (incl. sketch map), 1970
CODEN: CDMIAR
Subfile: B
Doc Type: SERIAL
Languages: English
Descriptors: *California; *Mineral resources ; Areal geology; United States ; Stratigraphy; structural geology; Mojave Desert; ore deposits
Section Headings: 13 .(AREAL GEOLOGY, GENERAL)

633620 72-14705

A model for the young structure of the Mojave Desert and its relations with the adjacent regions [abstr.]
Garfunkel, Zvi.

in Cordilleran Section, 68th Annual Meeting,
Geol. Soc. Am., Abstr. Vol. 4, No. 3, p. 160, 1972
CODEN: GAAPBC
Subfile: B
Doc Type: SERIAL
Languages: English
Descriptors: *California; *Faults; *Tectonophysics ; Structural geology; Displacements; Plate tectonics ; Mojave Desert; Strike-slip; San Andreas fault; United States; Majave Desert
Section Headings: 16 .(STRUCTURAL GEOLOGY)

633600 72-14685

Stratigraphy and tectonic framework of Mesozoic rocks of the Devil's Playground area Mojave Desert, California [abstr.]
Dunne, George C.

in Cordilleran Section, 68th Annual Meeting,
Geol. Soc. Am., Abstr. Vol. 4, No. 3, p. 151, 1972
CODEN: GAAPBC
Subfile: B
Doc Type: SERIAL
Languages: English
Descriptors: *California; *Mesozoic; *tectonics; *Volcanology ; Stratigraphy; United States; Structure; Volcanism ; Devil's Playground; interpretation; lower Mesozoic; Island arcs
Section Headings: 12 .(STRATIGRAPHY, HISTORICAL GEOLOGY)

619594 72-00640

Petroleum Potential of Sierra Nevada and Eastern Desert, California
Alpha, Andrew G.

in Future petroleum provinces of the United States; their geology and potential, Vol. 1,
Am. Assoc. Pet. Geol., Mem. No. 15, p. 363-371, sketch maps , 1971
CODEN: MAPGAN
Subfile: B
Doc Type: SERIAL
Languages: English
Descriptors: *California; *Sedimentary rocks; *Petroleum; *Tectonics; *Paleozoic; *Mesozoic; *Tertiary ; Areal geology; Lithostratigraphy; United States ; Economic geology; stratigraphy; structural geology; Sierra Nevada; Mojave Desert; Great Basin; possibilities; structural complexes
Section Headings: 13 .(AREAL GEOLOGY, GENERAL)

588069 71-07293

Structural geology of the Ivanpah mountains, Mojave desert, California [abstr.]
Patchick, Paul F.
Geol. Soc. Am., Abstr. Vol. 3, No. 2, p. 175-176, 1971
CODEN: GAAPBC
Subfile: B
Doc Type: SERIAL
Languages: English
Descriptors: *California; *tectonics ; Structural geology ; Mojave desert; Ivanpah mountains
Section Headings: 16 .(STRUCTURAL GEOLOGY)

588012 71-07236

Time-interval of stress change in the eastern Mojave desert, California and its possible relationship to seafloor spreading [abstr.]
Kupfer, Donald H.
Geol. Soc. Am., Abstr. Vol. 3, No. 2, p. 145, 1971
CODEN: GAAPBC
Subfile: B
Doc Type: SERIAL
Languages: English
Descriptors: *California; *tectonics; *sea-floor spreading ; Structural geology ; Mojave desert
Section Headings: 16 .(STRUCTURAL GEOLOGY)

576191 70-28627

Geology and hydrology of Coyote playa
Hagar, David J.

in Geology and hydrology of selected playas in western United States, p. 66-107, illus. (incl. sketch maps),
Mass., Univ. Amherst, 1970
Subfile: B
Languages: English
Surface, subsurface, Mojave desert, California
Descriptors: *Geomorphology; *California; *hydrogeology ; Environment; General ; Desert; Coyote playa; Mojave desert
Section Headings: 23 .(SURFICIAL GEOLOGY, GEOMORPHOLOGY)

576190 70-28626

Geology and hydrology of Rogers playa and Rosamond playa, California
Motts, Ward S.; Carpenter, David.

in Geology and hydrology of selected playas in western United States, p. 23-65, illus. (incl. sketch maps),
Mass., Univ. Amherst, 1970
Subfile: B
Languages: English
Surface and subsurface geology, Mojave desert
Descriptors: *Geomorphology; *California; *hydrogeology ; Environment; General ; Desert; Rosamond playa; Rogers playa; Mojave desert
Section Headings: 23 .(SURFICIAL GEOLOGY, GEOMORPHOLOGY)

506193 69-09500

Possible relationship of faults in the Mojave desert to the San Andreas fault [abstr., with discussion]
Troxel, Bennie W.

in Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.,
Stanford Univ. Publ., Geol. Sci. Vol. 11, p. 181-282, 1968
Subfile: B
Languages: English
Descriptors: *California; *faults; *Tectonics ; Structural geology; General ; Mojave desert; relation to San Andreas fault
Section Headings: 16 .(STRUCTURAL GEOLOGY)

472485 68-01841-N

Geology of the Fremont Peak and Opal Mountain quadrangles, California
Dibblee, T. W., Jr
California Div. Mines and Geology Bull. 188 64 p., illus., geol. maps, 1968
Subfile: N
Distribution, name, landform, field relations, lithology, age, and correlation of Mojave Desert rock units in these quadrangles are described. The pre-Tertiary basement complex--Mesozoic? granitic plutons enclosing pendants of Precambrian? gneiss--is cut by felsitic to porphyritic dikes, Cretaceous or younger. The Tertiary sequence includes new Jackhammer and Pickhandle Formations with associated Opal Mountain Volcanics; the Barstow Formation, redefined to include the here named basal Owl Conglomerate Member; and the Lane Mountain Andesite. Black Mountain Basalt of Quaternary age, alluvium, and other sediments are on the beveled surface. In a syncline cut by 3 NW-trending high-angle fault zones are folded Tertiary formations in an unstable block. Small amounts of pumice, perlite and quartz, placer gold and strontianite have been produced.
Descriptors: *California; *Faults; *Geomorphology; *Quaternary; *Tertiary ; Areal geology; Maps; geologic; Stratigraphy; High-angle; Landform evolution ; Fremont Peak and Opal Mtn. quadrangles; and Mud Hills area; Mesozoic-Cenozoic; Nomenclature; Jackhammer; Pickhandle; Barstow Formations

464573 69-08048-N

PEDIMENT EVOLUTION IN THE HALLORAN HILLS, CENTRAL MOJAVE DESERT, CALIFORNIA (WITH GERMAN AND ENGLISH SUMM.)
WARNKE, DETLEF A.
ZEITSCHR. GEOMORPHOLOGIE, NEW SER., V. 13, NO. 4, P. 357-389 1969
Subfile: N
Descriptors: *ARID CYCLE; *CALIFORNIA; *EROSION; *GENERALIZED OUTCROP PATTERNS; *GEOMORPHOLOGY; *HALLORAN HILLS ; *LANDFORM EVOLUTION; *LANDFORMS; *MAPS; *GEOLOGIC; *PEDIMENT EVOLUTION; *PEDIMENTS

453471 67-07485-N

Mojave River ground water basins investigation
California Dept. Water Resources
California Dept. Water Resources Bull. 84 151 p., illus., tables, geol. map, 1967
Subfile: N
Descriptors: *California; *Ground water ; Hydrogeology; Maps; geologic ; Mojave River basins; ground-water resources; Resources

445769 67-03485-N

Areal geology of the western Mojave Desert, California
Dibblee, Thomas W., Jr
U.S. Geol. Survey Prof. Paper 522 153 p., illus., tables, geol. map, 1967
Subfile: N
Descriptors: *Boron; *California; *Faults ; Areal geology; Maps; geologic; Block ; Mojave Desert; western; deposits ; Mojave block; structure

401438 64-05531-N

A geological reconnaissance in the southeastern Mojave Desert, California
Bassett, Allen M.; Kupfer, Donald H.
California Div. Mines and Geology Spec. Rept. 83 43 p., illus., geol. map, 1964
Subfile: N
The northwest half of this area in San Bernardino County contains predominantly Cenozoic volcanics with interbedded sedimentary rocks. In the southeast half are metamorphic rocks of Precambrian, Paleozoic, and Mesozoic(?) ages, all intruded by plutonic rocks of late Mesozoic age. Because of their complex and abruptly changing lithology and isolation in faulted mountain ranges, the Tertiary rocks, separated from older and younger by angular unconformity, are discussed under four separate areas. The only dated Tertiary beds are in the Cady Mountains where Miocene vertebrate fossils are found. Gravels, alluvium, playa sediments, basalts, and wind-blown sand of Tertiary or Quaternary and Quaternary ages are distributed throughout the mapped area.
Descriptors: *California; *faults; *Tertiary; *Quaternary; *Deserts; *Igneous rocks ; Areal geology; Volcanism; Maps; Structural geology; Volcanic ; Mojave Desert; southeastern ; Cenozoic; reconnaissance; southeast; geologic reconnaissance; topographic expression; lithology and distribution; sediments and basalts; geological reconnaissance; Cenozoic activity and trends

391410 63-00865-N

Wells and springs in the lower Mojave Valley area, San Bernardino County, California
Dyer, H. Bennett; Bader, J. S.; Giessner, F. W.
California Dept. Water Resources Bull. 91-10 p. 1-19, app. A-D, tables, geol. map, 1963
Subfile: N
Descriptors: *California; *Deserts; *Major-element analyses; *Ground water ; Hydrogeology; Maps; Areal geology ; Mojave Valley area; lower; wells and springs; Geologic; Mojave Valley

385059 62-01531-N

Geologic reconnaissance map of part of the southeastern Mojave Desert, California
Kupfer, Donald Harry; Bassett, Allen Mordorf
U.S. Geol. Survey Mineral Inv. Field Studies Map MF-205, scale 1:125,000, 1962
Subfile: N
Descriptors: *California ; Maps ; Geologic; Mojave Desert ; southeastern

383754 62-00186-N

Preliminary map showing valley-fill areas and source, occurrence, and movement of ground water in the western part of the Mojave Desert region, California
Kunkel, Fred
U.S. Geol. Survey Hydrol. Inv. Atlas HA-31, 1 sheet, scale 1:316,800, text, 1962
Subfile: N
Descriptors: *California; *ground water ; Areal geology; Hydrogeology; Maps ; Mojave Desert; western; Geologic and ground water; Occurrence

1126719 82-44614

Field trip number 7; Comparison of Mesozoic tectonics with mid-Tertiary detachment faulting in the Colorado River area, California, Arizona, and Nevada
Frost, E. G.(leader); Cameron, T. E.(leader); Martin, D. L.(leader)
San Diego State Univ., Dep. Geol. Sci., San Diego, CA, USA

Geologic excursions in the California desert
Cooper, J. D.(EDITOR)
Publ: Geol. Soc. Am.
111-159p., 1982
153 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
illus., sketch maps
Latitude: N340000; N360000 Longitude: W1140000; W1160000
Descriptors: *California; *Nevada; *Arizona; *faults ; structural geology; displacements ; tectonics; normal faults; Yuma County; Mojave County; Clark County; San Bernardino County; United States; Mesozoic; Phanerozoic; Tertiary; Cenozoic; Colorado River; compression tectonics; guidebook; road log; extension; decollement
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1126718 82-44449

Field trip number 13; Geology and mineral deposits of the central Mojave Desert
Flint, A. E.(leader); Phoenix, D.(leader)
Chapman Coll., Dep. Geol., Orange, CA, USA

Geologic excursions in the California desert
Cooper, J. D.(EDITOR)
Publ: Geol. Soc. Am.
101-109p., 1982
5 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
sketch map
Latitude: N340000; N353000 Longitude: W1170000; W1180000
Descriptors: *California ; economic geology ; mineral resources; San Bernardino County; Kern County; Los Angeles County; United States; guidebook; road log; gold ores; petroleum; San Andreas Fault; silver ores; tungsten ores; limestone deposits; boron deposits; Mojave Desert
Section Headings: 13 .(AREAL GEOLOGY, GENERAL)

1126711 82-44604

Aspects of early Miocene extension of the central Mojave Desert
Dokka, R. K.; Glazner, A. F.
La. State Univ., Dep. Geol., Baton Rouge, LA, USA; Univ. N. C., Dep. Geol., USA

Geologic excursions in the California desert
Cooper, J. D.(EDITOR)
Publ: Geol. Soc. Am.
31-45p., 1982
35 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
illus., sects., geol. sketch maps
Latitude: N342000; N354000 Longitude: W1140000; W1170000
Descriptors: *California; *faults; *igneous rocks ; structural geology; displacements; volcanic rocks ; tectonics; normal faults; calc-alkalic composition; San Bernardino County; United States; Mojave Desert; lower Miocene; Miocene; Neogene; Tertiary; Garlock Fault; San Andreas Fault; extension; volcanism; magmas
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1126710 82-44603

Field trip roadlog; Late Cenozoic tectonic and structural evolution of the central Mojave Desert, California
Dokka, R. K.; Glazner, A. F.
La. State Univ., Baton Route, LA, USA; Univ. N. C., Dep. Geol., USA

Geologic excursions in the California desert
Cooper, J. D.(EDITOR)
Publ: Geol. Soc. Am.
1-30p., 1982
44 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
Note: Field trip No. 2; Dokka, R. K., and Glazner, A. F., leaders, illus., sects., strat. cols., geol sketch maps
Latitude: N342000; N354000 Longitude: W1140000; W1170000
Descriptors: *California; *igneous rocks ; structural geology; composition ; tectonics; distribution; San Bernardino County County; Barstow Formation; United States; Neogene; Tertiary; Cenozoic; Quaternary; guidebook; road log; Mojave Desert; San Bernardino County; Lenwood Fault; Camp Rock Fault; Calico Fault; Pisgah Fault
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1126709 82-44421

Geologic excursions in the California desert
Cooper, J. D.(EDITOR)
Publ: Geol. Soc. Am.
159p., 1982
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: MONOGRAPHIC
Languages: English
Note: 78th annual meeting of the Cordilleran Section, Geological Society of America, Anaheim, CA; April 19-21, 1982; individual papers are cited separately., illus.
Latitude: N340000; N360000 Longitude: W1140000; W1180000
Descriptors: *California ; areal geology ; guidebook; San Bernardino County; Kern County; Los Angeles County; United States; Mojave Desert; road log; tectonics; igneous activity; mineral resources
Section Headings: 13 .(AREAL GEOLOGY, GENERAL)

1109000 82-29344

Cenozoic evolution of the Mojave Block and adjacent areas
Glazner, A.
Univ. of California, Los Angeles, CA, USA
189p., 1981
Subfile: B
Degree Level: Doctoral
Country of Publ.: United States
Doc Type: THESIS Bibliographic Level: MONOGRAPHIC
Languages: English
Availability: Univ. Microfilms
Descriptors: *California; *Southwestern U.S. ; structural geology; tectonophysics ; tectonics; plate tectonics; United States; Southern California; Mojave Desert; orogeny; volcanism; Miocene; Neogene; Tertiary; faults; subduction; mechanism; continental crust; upper Oligocene; Oligocene; Paleogene; Cenozoic; decollement
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1108834 82-31856

Selective extraction of tungsten from Searles Lake brines
Altringer, P. B.; Brooks, P. T.; McKinney, W. A.
U. S. Bur. Mines, Salt Lake City Res. Cent., Salt Lake City, UT, USA

Second symposium on separation science and technology for energy applications
Malinauskas, A. P.(EDITOR)
Oak Ridge Natl. Lab., Oak Ridge, TN, USA
Second symposium on separation science and technology for energy applications, Gatlinburg, TN, United States, May 5-8, 1981
Separation Science and Technology 16: 9, 1053-1069p., 1981
CODEN: SSTEDS ISSN: 0149-6395 3 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; CONFERENCE PUBLICATION Bibliographic Level: ANALYTIC
Languages: English
illus., 1 table
Descriptors: *California ; economic geology ; tungsten ores; San Bernardino County; United States; brines; recovery; Searles Lake; technology; ion exchange; Mojave Desert; chemical composition; properties
Section Headings: 27 .(ECONOMIC GEOLOGY, METALS)

1107922 82-29152

Geology and structure of the Paradise Range, Mojave Desert, California
Wust, S. L.
Stanford Univ., Stanford, CA, USA
unknownp., 1981
Subfile: B
Degree Level: Master's
Country of Publ.: United States
Doc Type: THESIS Bibliographic Level: MONOGRAPHIC
Languages: English
Latitude: N350000; N352000 Longitude: W1160000; W1170000
Descriptors: *California; *metamorphic rocks; *structural analysis ; areal geology; metasedimentary rocks; interpretation ; Paradise Range; petrology; interference patterns; San Bernardino County; United States; Mojave Desert; Lane Mountain Quadrangle; Southern California; folds; faults; plutonic rocks; absolute age; tectonics
Section Headings: 13 .(AREAL GEOLOGY, GENERAL)

1107881 82-31839

Geology and mineral deposits of the Bagdad Chase Mine and vicinity, Stedman District, San Bernardino County, California
Polovina, J. S.
Univ. of California, Los Angeles, CA, USA
unknownp., 1980
Subfile: B
Degree Level: Master's
Country of Publ.: United States
Doc Type: THESIS Bibliographic Level: MONOGRAPHIC
Languages: English
Descriptors: *California; *intrusions; *mineral deposits; *genesis ; economic geology; metal ores; sills ; petrology ; hydrothermal processes; San Bernardino County; United States; gold ores; copper ores; silver ores; Bagdad Chase Mine; Stedman District; Bullion Mountains; Mojave Desert; mineral deposits, genesis; breccia; clastic rocks; Basin and Range Province
Section Headings: 27 .(ECONOMIC GEOLOGY, METALS)

1098695 82-17385

The timing and style of Cenozoic deformation in the Basin and Range Province of southwestern Arizona interpreted from geologic events along the Colorado Plateau margin
Young, R. A.
State Univ. N.Y., Coll. at Geneseo, Dep. Geol. Sci., Geneseo, NY, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 123-125p., 1981
CODEN: XGROAG ISSN: 0196-1497 5 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
sketch map
Latitude: N350000; N363000 Longitude: W1133000; W1143000
Descriptors: *geomorphology; *Arizona; *Basin and Range Province; *Colorado Plateau; *volcanology ; landform evolution; structural geology; petrology; volcanism ; plateaus; tectonics; evolution; Mohave County; Peach Springs Tuff; USGS; United States; Mojave Desert; Sonoran Desert; Cenozoic; Phanerozoic; tuff; pyroclastics and glasses; normal faults; faults; transition zones
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1098694 82-16130

Geology and structure of the Paradise Range, Mojave Desert, California
Wust, S. L.
Stanford Univ., Dep. Geol., Stanford, CA, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 121-122p., 1981
CODEN: XGROAG ISSN: 0196-1497 3 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
Latitude: N345500; N353000 Longitude: W1160000; W1170000
Descriptors: *California; *metamorphic rocks ; petrology; metasedimentary rocks ; San Bernardino County; USGS; United States; Southern California; Paradise Range; Mojave Desert; tectonics; Basin and Range Province; faults
Section Headings: 05 .(PETROLOGY, IGNEOUS AND METAMORPHIC)

1098692 82-17378

Colorado Plateau margin in the West Clear Creek region of central Arizona
Ulrich, G. E.
U. S. Geol. Surv., Flagstaff, AZ, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 116-118p., 1981
CODEN: XGROAG ISSN: 0196-1497 3 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
sects.
Latitude: N340000; N350000 Longitude: W1110000; W1120000
Descriptors: *Arizona; *faults; *geomorphology; *volcanology ; *Colorado Plateau ; structural geology; displacements; landform evolution; volcanism; petrology ; tectonics; normal faults; plateaus; evolution; Coconino County; USGS; United States; Neogene; Tertiary; Cenozoic; Clear Creek; volcanic rocks; folds; Laramide Orogeny; orogeny
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1098691 82-20443

Late Cretaceous to late Tertiary base- and precious-metal mineralization, South-central Arizona
Tosdal, R. M.
U. S. Geol. Surv., Menlo Park, CA, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 113-115p., 1981
CODEN: XGROAG ISSN: 0196-1497 8 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
Latitude: N313000; N323000 Longitude: W1113000; W1130000
Descriptors: *Arizona; *mineral deposits; *genesis ; economic geology; metal ores ; mineralization; Pima County; USGS; United States; Ajo; Papago Indian Reservation; Basin and Range Province; base metals; precious metals; copper ores; molybdenum ores; porphyry copper; porphyry molybdenum; vein systems; structural controls; hydrothermal processes; age; Tertiary; Cenozoic; Upper Cretaceous; Cretaceous; mineral deposits, genesis
Section Headings: 27 .(ECONOMIC GEOLOGY, METALS)

1098690 82-17375

Deformation patterns in the Peninsular Ranges Batholith, San Diego County, California
Todd, V. R.; Shaw, S. E.

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 110-112p., 1981
CODEN: XGROAG ISSN: 0196-1497 8 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
illus., geol. sketch map
Latitude: N324500; N330000 Longitude: W1161500; W1165000
Descriptors: *California; *structural analysis; *intrusions; *metamorphic rocks ; structural geology; interpretation; metaplutonic rocks; batholiths ; emplacement; genesis; San Diego County; USGS; United States; Southern California; Peninsular Ranges; tectonics; xenoliths; gneisses; mylonitic gneiss; plate tectonics
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1098688 82-16911

Paleozoic metasedimentary rocks of the southeastern Mojave Desert region, California and western Arizona
Stone, P.; Howard, K. A.; Hamilton, W. B.
U. S. Geol. Surv., Menlo Park, CA, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 104-106p., 1981
CODEN: XGROAG ISSN: 0196-1497 3 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
chart, sketch map
Latitude: N334500; N350000 Longitude: W1140000; W1160000
Descriptors: *California; *Arizona; *paleogeography; *metamorphic rocks ; stratigraphy; Paleozoic; lithostratigraphy ; Mohave County; Yuma County; Riverside County; San Bernardino County; USGS; United States; Southern California; Mojave Desert; tectonics; decollement; Basin and Range Province; Phanerozoic; metasedimentary rocks
Section Headings: 12 .(STRATIGRAPHY, HISTORICAL GEOLOGY)

1098687 82-17517

Early and middle Paleozoic margin of the North American continent in the southwestern United States and northern Mexico
Stewart, J. H.
U. S. Geol. Surv., Menlo Park, CA, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 101-103p., 1981
CODEN: XGROAG ISSN: 0196-1497 15 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
sketch maps
Descriptors: *North America; *Southwestern U.S.; *Mexico; *paleogeography ; tectonophysics; stratigraphy; Paleozoic ; continental drift; USGS; Upper Cambrian; Cambrian; Middle Pennsylvanian; Pennsylvanian; continental margin; plate boundaries; United States; Mojave Desert; Sonora; California; crystalline rocks; Phanerozoic; plate tectonics ; rotation
Section Headings: 18 .(GEOPHYSICS, SOLID EARTH)

1098685 82-20420

Qualitative analysis of airborne gamma-ray geophysical data in the California desert
Shumaker, M. W.
U. S. Bur. Land Manage., Riverside, CA, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 99p., 1981
CODEN: XGROAG ISSN: 0196-1497
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
Latitude: N323000; N354800 Longitude: W1141000; W1212000
Descriptors: *California; *mineral exploration ; economic geology; geophysical surveys ; uranium ores; radioactivity surveys; Inyo County; San Bernardino County; USGS; United States; Southern California; Mojave Desert; deserts; airborne methods; geophysical methods; gamma-ray methods; thorium ores; anomalies
Section Headings: 27 .(ECONOMIC GEOLOGY, METALS)

1098684 82-17349

Newly discovered sliver of Rand(?) Schist within the San Emigdio Mountains (southernmost Sierra Nevada tail), California
Ross, D. C.
U. S. Geol. Surv., Menlo Park, CA, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 96-98p., 1981
CODEN: XGROAG ISSN: 0196-1497 1 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
illus., geol. sketch map
Latitude: N345000; N345500 Longitude: W1190500; W1191500
Descriptors: *California; *faults; *metamorphic rocks ; structural geology; displacements; schists ; tectonics; transcurrent faults; occurrence; Kern County; Rand Schist; USGS; United States; Southern California; San Emigdio Mountains; Sierra Nevada
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1098683 82-17348

A hypothesis to explain anomalous structures in the western Basin and Range Province
Roquemore, G. R.
Nav. Weapons Cent., China Lake, CA, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 93-95p., 1981
CODEN: XGROAG ISSN: 0196-1497 9 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
sketch map
Latitude: N323000; N354800 Longitude: W1141000; W1212000
Descriptors: *California; *Basin and Range Province; *faults ; structural geology; distribution ; neotectonics; orientation; USGS; United States; Southern California; block structures; normal faults; transition zones; plate tectonics; rotation
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1098682 82-17343

Principal tectonic effects of the mid-Tertiary orogeny in the Sonoran Desert Province
Rehrig, W. A.
Conoco, Spec. Geol. Stud. Group, Denver, CO, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 90-92p., 1981
CODEN: XGROAG ISSN: 0196-1497
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv Sect., West. Distrib. Branch, Denver, CO, United States
sects., sketch map
Latitude: N330000; N340000 Longitude: W1133000; W1143000
Descriptors: *Arizona; *orogeny ; structural geology; mechanism ; tectonics; plate tectonics; Yuma County; USGS; normal faults; faults; United States; Sonoran Desert; Basin and Range Province; Oligocene; Paleogene; Tertiary; Cenozoic; lower Miocene; Miocene; Neogene; mylonitization; igneous activity; igneous rocks; geochemistry; crust; extension
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1098681 82-17341

Geology of the crystalline basement complex, eastern Transverse Ranges, southern California; constraints on regional tectonic interpretation
Powell, R. E.
Calif. Inst. Technol., Div. Geol. and Planet. Sci., Pasadena, CA, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 87-89p., 1981
CODEN: XGROAG ISSN: 0196-1497 11 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
Latitude: N333000; N340000 Longitude: W1150000; W1170000
Descriptors: *California; *metamorphic rocks; *faults ; structural geology; distribution; displacements ; tectonics ; complexes; thrust faults; Riverside County; USGS; United States; Southern California; Transverse Ranges; Basin and Range Province; strike-slip faults; terrains; foliation
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1098680 82-16869

Lower and middle Paleozoic eugeosynclinal rocks in the El Paso Mountains, northwestern Mojave Desert, California
Poole, F. G.; Christiansen, R. L.; Carr, M. D.; Ross, R. J., Jr.
U. S. Geol. Surv., Denver, CO, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 85-86p., 1981
CODEN: XGROAG ISSN: 0196-1497 4 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
Latitude: N344000; N353000 Longitude: W1170000; W1183000
Descriptors: *California; *conodonts; *graptolites ; stratigraphy; biostratigraphy ; Devonian; Ordovician; USGS ; United States; Southern California; El Paso Mountains; Mojave Desert; tectonics; geosynclines; Basin and Range Province; Paleozoic; allochthons; sedimentary rocks
Section Headings: 12 .(STRATIGRAPHY, HISTORICAL GEOLOGY)

1098679 82-17332

Structural geology of the Date Creek basin area, West-central Arizona
Otton, J. K.
U. S. Geol. Surv., Denver, CO, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 82-84p., 1981
CODEN: XGROAG ISSN: 0196-1497 3 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
sects., sketch map
Latitude: N341000; N342500 Longitude: W1133000; W1134500
Descriptors: *Arizona; *faults ; structural geology; displacements ; tectonics; normal faults; Mohave County; USGS; Date Creek basin; United States; sedimentation; Basin and Range Province; tectonic controls; electrical surveys; geophysical surveys
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1098677 82-17316

The Sonoma Orogeny in the Mojave Desert?
Miller, E. L.
Stanford Univ., Dep. Geol., Stanford, CA, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 76-78p., 1981
CODEN: XGROAG ISSN: 0196-1497 16 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
geol. sketch map
Latitude: N340000; N354500 Longitude: W1141500; W1174000
Descriptors: *California; *orogeny ; structural geology; evolution ; tectonics; Sonoman Orogeny; San Bernardino County; USGS; United States; Southern California; Mojave Desert; Basin and Range Province; Permian; Paleozoic; Triassic; Mesozoic
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1098674 82-16021

The structure and stratigraphy of Miocene volcanic rocks in the Woods Mountains area, eastern Mojave Desert, San Bernardino County, California
McCurry, M.
Univ. Calif., Dep. Earth and Space Sci., Los Angeles, CA, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 67-69p., 1981
CODEN: XGROAG ISSN: 0196-1497 4 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
sketch map
Latitude: N345000; N351000 Longitude: W1145000; W1153000
Descriptors: *California; *igneous rocks; *volcanology ; stratigraphy; volcanic rocks; volcanism ; Miocene; petrology; calderas; San Bernardino County; USGS; United States; Southern California; Woods Mountains; Mojave Desert ; tectonics; Basin and Range Province; Neogene; Tertiary
Section Headings: 05 .(PETROLOGY, IGNEOUS AND METAMORPHIC)

1098672 82-15772

K/Ar dating in the Big Maria Mountains, Little Maria Mountains, and Palen Pass area, Riverside County, California
Martin, D. L.; Krummenacher, D.; Frost, E. G.
San Diego State Univ., Dep. Geol. Sci., San Diego, CA, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 63-64p., 1981
CODEN: XGROAG ISSN: 0196-1497 4 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
Latitude: N333000; N340000 Longitude: W1143000; W1174000
Descriptors: *California; *absolute age ; geochronology; dates ; metamorphic rocks; Riverside County; USGS; United States; Southern California; Big Maria Mountains; Little Maria Mountains; Palen Pass; Basin and Range Province; K/Ar ; overprinting; Precambrian; Mesozoic; Phanerozoic; tectonics
Section Headings: 03 .(GEOCHRONOLOGY)

1098669 82-17476

Heat flow and its implications for tectonics and volcanism in the Basin and Range Province
Lachenbruch, A. H.; Sass, J. H.
U. S. Geol. Surv., Menlo Park, CA, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 56-58p., 1981
CODEN: XGROAG ISSN: 0196-1497 18 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
sketch map
Descriptors: *California; *Arizona; *Southwestern U.S.; *Nevada; *Basin and Range Province ; tectonophysics; structural geology ; heat flow; crust; tectonics; USGS; United States; Southern California; Mojave Desert; Sonoran Desert; volcanism
Section Headings: 18 .(GEOPHYSICS, SOLID EARTH)

1098668 82-17306

Observations and speculations regarding the relations and origins of mylonitic gneiss and associated detachment faults near the Colorado Plateau boundary in western Arizona
Lucchitta, I.; Suneson, N.
U. S. Geol. Surv., Flagstaff, AZ, USA; Chevron Resour. Co., USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 53-55p., 1981
CODEN: XGROAG ISSN: 0196-1497 4 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
Latitude: N340000; N370000 Longitude: W1123000; W1143000
Descriptors: *Colorado Plateau; *Arizona; *metamorphic rocks ; structural geology; gneisses ; tectonics; mylonitic gneiss; USGS; United States; mylonites; faults; genesis; complexes; core complexes; metamorphic core complexes; decollement; mylonitization
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1098667 82-17471

Regional gravity studies, northern Sonora, Mexico
Kleinkopf, M. D.
U. S. Geol. Surv., Denver, CO, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 51-52p., 1981
CODEN: XGROAG ISSN: 0196-1497 3 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
sketch map
Latitude: N303000; N313000 Longitude: W1085000; W1120000
Descriptors: *Mexico ; geophysical surveys; tectonophysics ; gravity surveys; crust; USGS; North America; Sonora; Sonoran Desert; Bouguer anomalies; tectonics; geophysical profiles
Section Headings: 18 .(GEOPHYSICS, SOLID EARTH)

1098665 82-17286

A kinematic framework for contemporary block tectonics
Hill, D. P.
U. S. Geol. Surv., Menlo Park, CA, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 45-47p., 1981
CODEN: XGROAG ISSN: 0196-1497
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
illus.
Descriptors: *California; *Nevada; *Basin and Range Province ; *faults ; structural geology; systems ; neotectonics; block structures; USGS; United States; kinematics; mechanics
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1098664 82-17285

Late Cretaceous and early Tertiary thrust faulting, regional metamorphism, and granitic plutonism, South-central Arizona
Haxel, G.; Tosdal, R. M.; May, D. J.; Wright, J. E.
U. S. Geol. Surv., Menlo Park, CA, USA; Univ. Calif., USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 42-44p., 1981
CODEN: XGROAG ISSN: 0196-1497 13 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
Latitude: N313000; N323000 Longitude: W1110000; W1130000
Descriptors: *Arizona; *faults; *metamorphism ; structural geology; displacements; regional metamorphism ; tectonics; thrust faults; evolution; Pima County; USGS; Upper Cretaceous; Cretaceous; Paleogene; Tertiary; Cenozoic; United States; Basin and Range Province; orogeny; plutons; intrusions; granites; igneous activity
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1098662 82-17277

Tectonic significance of the stratigraphy and distribution of Cenozoic volcanic rocks in the central Mojave Desert
Glazner, A. F.
Univ. Calif., Dep. Earth and Space Sci., Los Angeles, CA, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 39-40p., 1981
CODEN: XGROAG ISSN: 0196-1497
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
sect., sketch map
Latitude: N343000; N350000 Longitude: W1160000; W1163000
Descriptors: *California; *igneous rocks ; structural geology; stratigraphy; volcanic rocks ; tectonics; Cenozoic; distribution; San Bernardino County; USGS; United States; Southern California; Phanerozoic; Mojave Desert; Basin and Range Province; plate tectonics; volcanism
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1098660 82-17272

Mesozoic and Cenozoic deformation and igneous activity in the Little Maria Mountains, Riverside County, California
Emerson, W. S.
San Diego State Univ., Dep. Geol. Sci., San Diego, CA, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 35p., 1981
CODEN: XGROAG ISSN: 0196-1497
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
Latitude: N332500; N340000 Longitude: W1143000; W1154000
Descriptors: *California ; structural geology ; tectonics; Riverside County; USGS; United States; Southern California ; Little Maria Mountains; Basin and Range Province; Mesozoic; Phanerozoic; Cenozoic; folds; faults; igneous activity
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1098659 82-17271

Mid-Tertiary extensional orogeny of southwestern New Mexico and other parts of the Basin and Range Province
Elston, W. E.
Univ. N.M., Dep. Geol., Albuquerque, NM, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 32-34p., 1981
CODEN: XGROAG ISSN: 0196-1497 10 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
Descriptors: *New Mexico; *Basin and Range Province; *Southwestern U.S.; *orogeny ; structural geology; tectonophysics; evolution ; tectonics; plate tectonics; periodicity; USGS; volcanism; United States; Oligocene; Paleogene; Tertiary; Cenozoic; crust; extension
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1098658 82-17267

Early Miocene detachment faulting in the central Mojave Desert, California
Dokka, R. K.
La. State Univ., Dep. Geol., Baton Rouge, LA, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 29-31p., 1981
CODEN: XGROAG ISSN: 0196-1497
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
sects., sketch map
Latitude: N340000; N354500 Longitude: W1141500; W1174000
Descriptors: *California ; structural geology ; tectonics; San Bernardino County; USGS; United States; Southern California; Mojave Desert; Basin and Range Province; lower Miocene; Miocene; Neogene; Tertiary; decollement; faults
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1098657 82-17264

Regional structure of the Mojave Desert
Dibblee, T. W., Jr.
Univ. Calif., Dep. Geol., Santa Barbara, CA, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 26-28p., 1981
CODEN: XGROAG ISSN: 0196-1497 3 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
geol. sketch map
Latitude: N323000; N354800 Longitude: W1141000; W1212000
Descriptors: *California ; structural geology ; tectonics; San Bernardino County; Riverside County; Los Angeles County ; USGS; United States; Southern California; Mojave Desert; Basin and Range Province
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1098656 82-17263

Interaction of plutonism, metamorphism, and thrust faulting in a segment of the Cordillera during the Mesozoic
DeWitt, E.
6165 East Adobe Pl., Tucson, AZ, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 23-25p., 1981
CODEN: XGROAG ISSN: 0196-1497 9 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
sect.
Latitude: N353000; N363000 Longitude: W1150000; W1210000
Descriptors: *California; *orogeny; *Nevada; *faults ; structural geology; evolution; displacements ; tectonics; Cordilleran Orogeny; thrust faults; Inyo County; Tulare County; Fresno County; Kings County; Monterey County; Clark County; USGS; United States; Southern California; North American Cordillera; igneous activity; metamorphism; plate tectonics; Mesozoic; Phanerozoic
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1098654 82-17252

Tectonic history of the Vidal-Parker region, California and Arizona
Carr, W. J.
U. S. Geol. Surv., Denver, CO, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 18-20p., 1981
CODEN: XGROAG ISSN: 0196-1497
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
Latitude: N340000; N343000 Longitude: W1140000; W1144000
Descriptors: *California; *Arizona ; structural geology ; tectonics; Yuma County; San Bernardino County; USGS; United States; Southern California; Mojave Desert; Basin and Range Province
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1098652 82-20255

Uranium in the eastern Mojave and western Sonoran deserts, California, Nevada, and Arizona
Calzia, J. P.; Luken, M. D.
U. S. Geol. Surv., Menlo Park, CA, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 12-14p., 1981
CODEN: XGROAG ISSN: 0196-1497 6 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
illus., sketch map
Latitude: N330000; N363000 Longitude: W1123000; W1170000
Descriptors: *California; *Arizona; *Nevada ; economic geology ; uranium ores; San Bernardino County; Clark County ; Yavapai County; Mohave County; USGS; United States; Southern California; Mojave Desert; Basin and Range Province ; Sonoran Desert
Section Headings: 27 .(ECONOMIC GEOLOGY, METALS)

1098651 82-16743

Stratigraphy and structure of a portion of the Bristol Mountains, San Bernardino County, California
Brown, H.

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 10-11p., 1981
CODEN: XGROAG ISSN: 0196-1497 2 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
illus., sketch map
Latitude: N340000; N354500 Longitude: W1141500; W1174000
Descriptors: *California; *metamorphic rocks ; structural geology; stratigraphy; lithostratigraphy ; tectonics; Paleozoic; San Bernardino County; USGS; United States; Southern California; Phanerozoic; Mojave Desert; Basin and Range Province; metasedimentary rocks
Section Headings: 12 .(STRATIGRAPHY, HISTORICAL GEOLOGY)

1098650 82-17243

Middle and late Tertiary tectonics of a part of the Basin and Range Province in the vicinity of Lake Mead, Nevada and Arizona
Bohannon, R. G.
U. S. Geol. Surv., Denver, CO, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 7-9p., 1981
CODEN: XGROAG ISSN: 0196-1497 7 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
sketch map
Latitude: N354500; N370000 Longitude: W1134500; W1153000
Descriptors: *Nevada; *Arizona; *Basin and Range Province ; structural geology ; tectonics; Clark County; Mohave County ; USGS; United States; Tertiary; Cenozoic; Lake Mead
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1098649 82-17226

Structural ties between the Great Basin and Sonoran Desert sections of the Basin and Range Province
Anderson, R. E.
U. S. Geol. Surv., Denver, CO, USA

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 4-6p., 1981
CODEN: XGROAG ISSN: 0196-1497 9 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION
Bibliographic Level: ANALYTIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
sketch maps
Descriptors: *Nevada; *Great Basin; *Arizona; *Basin and Range Province ; structural geology ; tectonics; USGS; United States; Sonoran Desert
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1076929 81-61153

Canadian company has promising silver project in Southern California
Glass, J. R.
Dusty Mac Mines, CAN
Western Miner (Vancouver) 54: 6, 46-47p., 1981
CODEN: WEMNAV ISSN: 0043-3934
Subfile: B
Country of Publ.: Canada
Doc Type: SERIAL Bibliographic Level: ANALYTIC
Languages: English
sketch map
Latitude: N345500; N345500 Longitude: W1170100; W1170100
Descriptors: *mineral exploration; *California ; geochemical methods; economic geology ; silver ores; San Bernardino County; Calico Formation; United States; Southern California; Barstow; middle Miocene; Miocene; Neogene; Tertiary; Calico Mountains; Mojave Desert; Basin and Range Province; cerargyrite; embolite; resources; development
Section Headings: 27 .(ECONOMIC GEOLOGY, METALS)

1076846 81-58550

Tectonic framework of the Mojave and Sonoran deserts, California and Arizona
Howard, K. A.(EDITOR); Carr, M. D.(EDITOR); Miller, D. M.(EDITOR)
U. S. Geol. Surv., Menlo Park, CA, USA
Tectonic framework of the Mojave and Sonoran deserts, California and Arizona, Menlo Park, CA, United States, Nov. 4-6, 1980
Open-File Report (United States Geological Survey. 1978) 81-0503, 130p., 1981
CODEN: XGROAG ISSN: 0196-1497
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; CONFERENCE PUBLICATION Bibliographic Level: MONOGRAPHIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States
illus.
Latitude: N340000; N353000 Longitude: W1130000; W1180000
Descriptors: *California; *Arizona; *Basin and Range Province; *symposia ; structural geology ; tectonics; Yuma County; San Bernardino County; USGS; United States; Mojave Desert; Sonoran Desert; deserts; neotectonics
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1075544 81-58552

Late Cenozoic tectonics of the central Mojave Desert, California
Dokka, R. K.
Univ. of Southern California, Los Angeles, CA, USA
unknownp., 1980
Subfile: B
Degree Level: Doctoral
Country of Publ.: United States
Doc Type: THESIS Bibliographic Level: MONOGRAPHIC
Languages: English
Availability: Univ. Microfilms
Latitude: N343000; N353000 Longitude: W1160000; W1173000
Descriptors: *California; *faults ; structural geology; displacements ; neotectonics; active faults; San Bernardino County; United States; Southern California; Mojave Desert; Newberry Mountains; reverse faults; wrench faults; strike-slip faults; Neogene; Tertiary; Cenozoic; Quaternary; tectonics; crust
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1074705 81-58582

Mojave Desert and environs
Burchfiel, B. C.; Davis, G. A.
Mass. Inst. Technol., Dep. Earth Planet. Sci., Cambridge, MA, USA; Univ. South. Calif., Dep. Geol. Sci., Los Angeles, CA, USA

The geotectonic development of California; Rubey Volume I
Ernst, W. G.(EDITOR)
Univ. Calif. Los Angeles, Dep. Earth Space Sci., Los Angeles, CA, USA
Publ: Prentice-Hall
217-252p., 1981
ISBN: 0-13-3539-385
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
illus., sects., geol. sketch maps
Latitude: N330000; N360000 Longitude: W1140000; W1190000
Descriptors: *California ; stratigraphy; structural geology ; paleogeography; tectonics; Pahrump Group; United States; Mojave Desert; Precambrian; Paleozoic; Phanerozoic ; Mesozoic
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1072170 81-58381

Geologic cross sections from Patton Ridge to the Mojave Desert, across the Los Angeles Basin, southern California
Crowell, J. C.; Beyer, L. A.; Biehler, S.; Ehlig, P. L.; Hall, E. A.; Junger, A.; Vedder, J. G.
Map and Chart Series (Geological Sociey of America) MC-28K, unpaginatedp., 1980
CODEN: MSGADL ISSN: 0272-0795 11 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; MAP Bibliographic Level: MONOGRAPHIC
Languages: English
Note: Geodynamics Project, sects.; 1:250,000; colored geol. map
Latitude: N320000; N350000 Longitude: W1170000; W1210000
Descriptors: *California ; areal geology ; maps; United States; geologic maps; explanatory text; offshore; continental shelf; plate boundaries; Patton Ridge; Mojave Desert; Los Angeles Basin; southern California; sections
Section Headings: 13 .(AREAL GEOLOGY, GENERAL)

1067065 81-48592

Geology and mineral wealth of the California desert; field trip guide
Fife, D.; LaViolette, J.; Unruh, M. E.
South Coast Geol. Soc., Santa Ana, CA, USA

Geology and mineral wealth of the California desert
Fife, D. L.(EDITOR); Brown, A. R.(EDITOR)
Publ: South Coast Geol. Soc.
542-555p., 1980
Subfile: B
Country of Publ.: United States
Doc Type: BOOK; MAP Bibliographic Level: ANALYTIC
Languages: English
Dibblee Volume, illus., block diag.; index map
Latitude: N322500; N374500 Longitude: W1141000; W1185000
Descriptors: *California ; areal geology ; guidebook; United States; Mojave Desert; road log; Cajon Pass; Oro Grande; Atolia; Red Mountain; Cantil Valley; Randsburg; Calico Mountains; Zzyzx; Afton Canyon; Mountain Pass; Cima ; Hector
Section Headings: 13 .(AREAL GEOLOGY, GENERAL)

1067061 81-48810

Geophysical survey in the Ivanpah Valley and vicinity, eastern Mojave Desert, California
Carlisle, C. L.; Luyendyk, B. P.; McPherron, R. L.
Univ. Calif. Santa Barbara, Dep. Geol. Sci., Santa Barbara, CA, USA; Univ. Calif. Los Ang., Dep. Earth and Space Sci., Los Angeles, CA, USA

Geology and mineral wealth of the California desert
Fife, D. L.(EDITOR); Brown, A. R.(EDITOR)
Publ: South Coast Geol. Soc.
485-494p., 1980
6 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK; MAP Bibliographic Level: ANALYTIC
Languages: English
Dibblee Volume, illus., sect.; topogr. map
Descriptors: *California; *faults ; geophysical surveys; structural geology; systems ; surveys; tectonics; grabens; San Bernardino County; Goodsprings Dolomite; Teutonia quartz monzonite; United States; seismic surveys; gravity surveys; magnetic surveys; eastern Mojave Desert; Ivanpah Valley; Bouguer anomalies; refraction; gneisses; schists; normal faults
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1067054 81-48854

Late Conozoic tectonic evolution of Cajon Valley, Southern California
Foster, J. H.
Gary S. Rasmussen & Assoc., San Bernardino, CA, USA

Geology and mineral wealth of the California desert
Fife, D. L.(EDITOR); Brown, A. R.(EDITOR)
Publ: South Coast Geol. Soc.
430-440p., 1980
14 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK; MAP Bibliographic Level: ANALYTIC
Languages: English
Dibblee Volume, illus., sect.; 1:48,000; geol. map
Latitude: N340000; N350000 Longitude: W1170000; W1184500
Descriptors: *California ; structural geology; areal geology ; tectonics; maps; Crowder Formation; Harold Formation; Punchbowl Formation; United States; geologic maps; lithostratigraphy; upper Cenozoic; Cenozoic; paleocurrents; Cajon Valley; Mojave Desert
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1067047 81-51703

Molycorp's Mountain Pass operations
Warhol, W. N.
Molycorp, Los Angeles, CA, USA

Geology and mineral wealth of the California desert
Fife, D. L.(EDITOR); Brown, A. R.(EDITOR)
Publ: South Coast Geol. Soc.
359-366p., 1980
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
Dibblee Volume, illus., sect., sketch map
Latitude: N352000; N354000 Longitude: W1152000; W1154000
Descriptors: *California ; economic geology ; rare earth deposits; San Bernardino County; United States; Mountain Pass; Mescal Range; carbonatites; bastnaesite; carbonates; halides; igneous rocks; Mojave Desert
Section Headings: 27 .(ECONOMIC GEOLOGY, METALS)

1067046 81-51411

Mid to late(?) Tertiary base and precious metal mineralization, War Eagle Mine, Lead Mountain Quadrangle, San Bernardino County, California
Fife, D. L.
Converse, Ward, Davis and Dixon, Anaheim, CA, USA

Geology and mineral wealth of the California desert
Fife, D. L.(EDITOR); Brown, A. R.(EDITOR)
Publ: South Coast Geol. Soc.
352-358p., 1980
10 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
Dibblee Volume, illus., 2 tables, geol. sketch map
Latitude: N342000; N344000 Longitude: W1154000; W1160000
Descriptors: *California ; economic geology ; metal ores; San Bernardino County; United States; silver ores; lead ores; base metals; War Eagle Mine; epithermal deposits; Tertiary; Cenozoic; Lead Mountain Quadrangle; fault zones; volcanic rocks; veins; rhyodacite; andesite-rhyolite family; tuff; pyroclastics and glasses; Mojave Desert
Section Headings: 27 .(ECONOMIC GEOLOGY, METALS)

1067045 81-51451

Geology of the Silver Hills lead-silver deposit, Silurian Hills, California
Henderson, G. V.
Calif. State Polytech. Univ., Dep. Earth Sci., Pomona, CA, USA

Geology and mineral wealth of the California desert
Fife, D. L.(EDITOR); Brown, A. R.(EDITOR)
Publ: South Coast Geol. Soc.
349-351p., 1980
6 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
Dibblee Volume, illus., geol. sketch map
Latitude: N352000; N354000 Longitude: W1151000; W1161000
Descriptors: *California ; economic geology ; lead ores; silver ores; San Bernardino County; Pahrump Group; Riggs Formation; United States; Silurian Hills; Silver Hills; barite deposits; gravel; clastic sediments; sand; volcanic rocks; Mojave Desert
Section Headings: 27 .(ECONOMIC GEOLOGY, METALS)

1067044 81-51141

Geology of the Leviathan barite-silver mine, Calico Mountains, California
Henderson, G. V.
Calif. State Polytech. Univ., Pomona, CA, USA

Geology and mineral wealth of the California desert
Fife, D. L.(EDITOR); Brown, A. R.(EDITOR)
Publ: South Coast Geol. Soc.
346-348p., 1980
11 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
Dibblee Volume, illus., geol. sketch map
Latitude: N345000; N351000 Longitude: W1164000; W1170000
Descriptors: *California ; economic geology ; barite deposits; silver ores; San Bernardino County; United States ; Calico Mountains; Leviathan Mine; fault zones; volcanic breccia; tuff; pyroclastics and glasses; porphyritic andesite; veins; Mojave Desert
Section Headings: 26 .(ECONOMIC GEOLOGY, GENERAL & MINING)

1067043 81-51705

Calico silver district, San Bernardino County, California; update
Weber, F. H., Jr.
Calif. Div. Mines and Geol., Los Angeles, CA, USA

Geology and mineral wealth of the California desert
Fife, D. L.(EDITOR); Brown, A. R.(EDITOR)
Publ: South Coast Geol. Soc.
339-345p., 1980
12 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
Dibblee Volume, sect., geol. sketch maps
Latitude: N345000; N351000 Longitude: W1164000; W1170000
Descriptors: *California ; economic geology ; silver ores; San Bernardino County; Barstow Formation; Pickhandle Formation; United States; Calico District; Silver Bow Mine; Wall Street Canyon; Waterloo Deposit; Mojave Desert
Section Headings: 27 .(ECONOMIC GEOLOGY, METALS)

1067042 81-51459

The Telegraph gold mine, Halloran Springs Quadrangle, San Bernardino County, California
Ito, T.; Morgan, G. J.

Geology and mineral wealth of the California desert
Fife, D. L.(EDITOR); Brown, A. R.(EDITOR)
Publ: South Coast Geol. Soc.
336-338p., 1980
7 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
Dibblee Volume, illus., 1 table, sketch map
Latitude: N351000; N352000 Longitude: W1155000; W1160000
Descriptors: *California ; economic geology ; gold ores; San Bernardino County; United States; Telegraph Mine; production; Mojave Desert
Section Headings: 27 .(ECONOMIC GEOLOGY, METALS)

1067041 81-51410

Epithermal late Tertiary gold mineralization at the Shining Dawn Mine, Lane Mountain Quadrangle, California
Fife, D. L.
Converse, Ward, Davis and Dixon, Anaheim, CA, USA

Geology and mineral wealth of the California desert
Fife, D. L.(EDITOR); Brown, A. R.(EDITOR)
Publ: South Coast Geol. Soc.
330-335p., 1980
12 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
Dibblee Volume, illus., sect., geol. sketch map
Latitude: N345000; N351000 Longitude: W1164000; W1170000
Descriptors: *California ; economic geology ; gold ores; San Bernardino County; Waterman Gneiss; Jackhammer Formation ; Pickhandle Formation; United States; epithermal deposits; Shining Dawn Mine; Lane Mountain Quadrangle; Calico Mountains; Precambrian; Miocene; Neogene; Tertiary; hydrothermal alteration; metasomatism; granites; rhyolites; veins; thrust faults; faults; upper Tertiary; Mojave Desert
Section Headings: 27 .(ECONOMIC GEOLOGY, METALS)

1067039 81-51559

Mineralized hydrothermal breccias in the Stedman District, San Bernardino County, California
Polovina, J. S.
Univ. Calif. Los Ang., Dep. Earth and Space Sci., Los Angeles, CA, USA

Geology and mineral wealth of the California desert
Fife, D. L.(EDITOR); Brown, A. R.(EDITOR)
Publ: South Coast Geol. Soc.
314-317p., 1980
3 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
Dibblee Volume, illus., sect., sketch map
Latitude: N342000; N344000 Longitude: W1160000; W1161000
Descriptors: *California ; economic geology ; metal ores; San Bernardino County; United States; gold ores; silver ores; copper ores; hydrothermal breccia; veins; Stedman District; Bagdad Chase Mine; Bullion Mountains; rhyodacite; andesite-rhyolite family; quartz; silica minerals; framework silicates; silicates; hematite; oxides; chrysocolla; sheet silicates; malachite; carbonates; Mojave Desert
Section Headings: 27 .(ECONOMIC GEOLOGY, METALS)

1067038 81-51597

The Copper World Mine, northeastern San Bernardino County, California
Ruff, R. W.; Unruh, M. E.
Converse, Ward, Davis and Dixon, Anaheim, CA, USA

Geology and mineral wealth of the California desert
Fife, D. L.(EDITOR); Brown, A. R.(EDITOR)
Publ: South Coast Geol. Soc.
306-313p., 1980
10 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
Dibblee Volume, illus., geol. sketch map
Latitude: N353000; N353000 Longitude: W1153500; W1153500
Descriptors: *California ; economic geology ; copper ores; San Bernardino County; Teutonia quartz monzonite; Goodsprings Dolomite; United States; Copper World Mine; Mojave Desert; Clark District; Clark Mountains; open-pit mining; skarn; metasomatic rocks; history
Section Headings: 27 .(ECONOMIC GEOLOGY, METALS)

1067029 81-47273

Implications of Cenozoic volcanism in the Palo Verde Mountain volcanic field, southeastern California
Murray, K. S.
Univ. Calif. Davis, Dep. Geol., Davis, CA, USA

Geology and mineral wealth of the California desert
Fife, D. L.(EDITOR); Brown, A. R.(EDITOR)
Publ: South Coast Geol. Soc.
256-258p., 1980
6 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
Dibblee Volume,
Latitude: N331500; N333000 Longitude: W1144000; W1151500
Descriptors: *California; *volcanology ; petrology; volcanism ; Cenozoic; United States; Phanerozoic; Palo Verde Mountain; tectonics; Mojave Desert
Section Headings: 05 .(PETROLOGY, IGNEOUS AND METAMORPHIC)

1067025 81-48581

Tectonic and stratigraphic elements of the northern Avawatz Mountains, San Bernardino County, California
Brady, R. H., III; Troxel, B. W.; Butler, P. R.
Univ. Calif. Davis, Dep. Geol., Davis, CA, USA

Geology and mineral wealth of the California desert
Fife, D. L.(EDITOR); Brown, A. R.(EDITOR)
Publ: South Coast Geol. Soc.
224-234p., 1980
24 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
Dibblee Volume, illus., geol. sketch map
Latitude: N351000; N355000 Longitude: W1161000; W1164000
Descriptors: *California ; economic geology; structural geology ;. mineral resources; tectonics; San Bernardino County; United States; Garlock fault zone; wrench faults; faults; Avawatz Mountains; talc deposits; gold ores; silver ores; manganese ores; barite deposits; iron ores; lithostratigraphy; Mojave Desert
Section Headings: 13 .(AREAL GEOLOGY, GENERAL)

1067024 81-48925

Geologic structure of the Chocolate Mountain region, southeastern California
Murray, K. S.; Bell, J. W.; Crowe, B. M.; Miller, D. G.
Univ. Calif., Davis, CA, USA; Nevada Bur. Mines and Geol., Reno, NV, USA

Geology and mineral wealth of the California desert
Fife, D. L.(EDITOR); Brown, A. R.(EDITOR)
Publ: South Coast Geol. Soc.
221-223p., 1980
2 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
Dibblee Volume, illus., geol. sketch map
Latitude: N323000; N334000 Longitude: W1143000; W1160000
Descriptors: *California ; structural geology ; tectonics; United States; Chocolate Mountains; southeastern California ; San Andreas Fault; faults; Mojave Desert
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1067022 81-48595

The Barstow-Bristol Trough, central Mojave Desert, California
Gardner, D. L.
31604 Crystal Sands Road, Laguna Niguel, CA, USA

Geology and mineral wealth of the California desert
Fife, D. L.(EDITOR); Brown, A. R.(EDITOR)
Publ: South Coast Geol. Soc.
204-214p., 1980
26 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
Dibblee Volume, geol. sketch maps
Latitude: N345000; N355000 Longitude: W1164000; W1175000
Descriptors: *California ; areal geology; structural geology; economic geology ; Barstow-Bristol Trough; tectonics; mineral resources; United States; Mojave Desert; gold ores; tungsten ores; silver ores; barite deposits; mining; history
Section Headings: 13 .(AREAL GEOLOGY, GENERAL)

1067015 81-51362

Gold in the California desert
Clark, W. B.

Geology and mineral wealth of the California desert
Fife, D. L.(EDITOR); Brown, A. R.(EDITOR)
Publ: South Coast Geol. Soc.
128-139p., 1980
14 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
Dibblee Volume, illus., 1 table, geol. sketch maps
Latitude: N353000; N383000 Longitude: W1160000; W1200000
Descriptors: *California ; economic geology ; gold ores; San Bernardino County; Inyo County; Mono County; Kern County; United States; Mojave Desert; Southern California
Section Headings: 27 .(ECONOMIC GEOLOGY, METALS)

1067014 81-51124

Mineral resources of the California desert; an overview
Davis, J. F.; Anderson, T. P.

Geology and mineral wealth of the California desert
Fife, D. L.(EDITOR); Brown, A. R.(EDITOR)
Publ: South Coast Geol. Soc.
122-127p., 1980
4 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
Dibblee Volume,
Latitude: N322500; N374500 Longitude: W1141000; W1185000
Descriptors: *California ; economic geology ; mineral resources; United States; nonmetal deposits; boron deposits ; rare earth deposits; metal ores; gold ores; silver ores; tungsten ores; feldspar deposits; barite deposits; bentonite deposits; Mojave Desert; Colorado Desert; Southern California
Section Headings: 26 .(ECONOMIC GEOLOGY, GENERAL & MINING)

1067012 81-48844

Geologic structure of the Mojave Desert
Dibblee, T. W., Jr.
316 E. Mission St., Santa Barbara, CA, USA

Geology and mineral wealth of the California desert
Fife, D. L.(EDITOR); Brown, A. R.(EDITOR)
Publ: South Coast Geol. Soc.
69-100p., 1980
47 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
Dibblee Volume, sects., geol. sketch maps
Latitude: N330000; N363000 Longitude: W1143000; W1190000
Descriptors: *California; *faults ; structural geology; displacements ; tectonics; strike-slip faults; United States; Mojave Desert; evolution; Garlock fault zone; Death Valley fault zone; metasedimentary rocks; volcanic rocks; sedimentary rocks; geosynclines; Cordilleran Geosyncline; San Andreas Fault
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1067011 81-48238

Cenozoic rock units of the Mojave Desert
Dibblee, T. W., Jr.
316 E. Mission St., Santa Barbara, CA, USA

Geology and mineral wealth of the California desert
Fife, D. L.(EDITOR); Brown, A. R.(EDITOR)
Publ: South Coast Geol. Soc.
41-68p., 1980
56 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
Dibblee Volume, illus., charts, sects., geol. sketch maps
Latitude: N330000; N363000 Longitude: W1143000; W1190000
Descriptors: *California; *paleogeography ; stratigraphy; Tertiary; economic geology ; Cenozoic; mineral resources; Ricardo Formation; Black Mountain Basalt; United States; Phanerozoic; sedimentary rocks; volcanic rocks; lithostratigraphy; Mojave Desert; pyroclastics; clastic rocks; volcanic breccia; rhyolites; basalts; gold ores; silver ores; barite deposits; manganese ores; perlite; pyroclastics and glasses; pumice; zeolite group; framework silicates; silicates; gems; agate; silica minerals; jasper; alluvium; clastic sediments; San Andreas Fault; Cajon Basin; Garlock fault zone
Section Headings: 12 .(STRATIGRAPHY, HISTORICAL GEOLOGY)

1067010 81-48237

Pre-Cenozoic rock units of the Mojave Desert
Dibblee, T. W., Jr.
316 E. Mission St., Santa Barbara, CA, USA

Geology and mineral wealth of the California desert
Fife, D. L.(EDITOR); Brown, A. R.(EDITOR)
Publ: South Coast Geol. Soc.
13-40p., 1980
67 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: BOOK; MAP Bibliographic Level: ANALYTIC
Languages: English
Dibblee Volume, geol. map
Latitude: N330000; N363000 Longitude: W1143000; W1190000
Descriptors: *California ; stratigraphy; economic geology ; Phanerozoic; rare earth deposits; Mesquite Schist; Rand Schist; Pahrump Group; Pelona Schist; Orocopia Schist; United States; Mesozoic; Precambrian; lithostratigraphy; metamorphic rocks; plutonic rocks; Mojave Desert; Mountain Pass; gneisses; schists; mylonites; metasedimentary rocks; Paleozoic; San Bernardino Mountains; Chicopee Canyon; correlation; Quartzite Mountain; metavolcanic rocks; hypabyssal rocks; El Paso Mountains; Black Mountain; orogeny; Nevadan Orogeny; Laramide Orogeny
Section Headings: 12 .(STRATIGRAPHY, HISTORICAL GEOLOGY)

1057692 81-43028

Geology of the Victorville region, California
Miller, E. L.
Stanford Univ., Dep. Geol., Stanford, CA, USA
Geological Society of America Bulletin 92: 4, I 160-I 163, II 554-II 608p., 1981
CODEN: BUGMAF ISSN: 0016-7606 65 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; MAP Bibliographic Level: ANALYTIC
Languages: English
illus., strat. cols., sects.; geol. maps; print, microfiche
Latitude: N342000; N344000 Longitude: W1171500; W1173500
Descriptors: *California; *orogeny ; areal geology; evolution ; Mojave Desert; Cordilleran Orogeny; San Bernardino County; United States; Southern California; Victorville; Proterozoic; Precambrian; Paleozoic; Phanerozoic; sedimentary rocks; structure; paleogeography; tectonics; petrology; roof pendants; metamorphic rocks; geologic maps; maps
Section Headings: 13 .(AREAL GEOLOGY, GENERAL)

1046546 81-30481

Geology and mammalian biostratigraphy of a part of the northern Cady Mountains, Mojave Desert, California
Miller, S. T.
U. S. Geol. Surv., Menlo Park, CA, USA
Open-File Report (United States Geological Survey. 1978) 80-0878, 126p., 1980
CODEN: XGROAG ISSN: 0196-1497 85 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; MAP Bibliographic Level: MONOGRAPHIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., Branch Distrib., Denver, CO, United States
illus., tables, plates; maps
Latitude: N344500; N350000 Longitude: W1161500; W1163000
Descriptors: *California; *mammals ; stratigraphy; biostratigraphy ; Miocene; San Bernardino County; Hector Formation; lower Miocene; Neogene; Tertiary; United States ; Southern California; absolute age; Mojave Desert; USGS
Section Headings: 12 .(STRATIGRAPHY, HISTORICAL GEOLOGY)

1005764 80-44554

Allochthonous lower and middle Paleozoic eugeosynclinal rocks in El Paso Mountains, northwestern Mojave Desert, California
Poole, F. G.; Christiansen, R. L.
U. S. Geol. Surv., Denver, Colo., USA
The Geological Society of America, Cordilleran Section, 76th annual meeting, Corvallis, Oreg., United States, March 19-21, 1980
Geol. Soc. Am., Abstr. Programs 12: 3, 147p., 1980
CODEN: GAAPBC ISSN: 0016-7592
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; CONFERENCE PUBLICATION Bibliographic Level: ANALYTIC
Languages: English
Latitude: N343000; N360000 Longitude: W1170000; W1183000
Descriptors: *California; *Porifera; *conodonts ; stratigraphy; structural geology; biostratigraphy ; Paleozoic; tectonics; United States; Mojave Desert; El Paso Mountains; allochthons; geosynclines; eugeosynclines; lower Paleozoic; middle Paleozoic; Graptolithina; Radiolaria; structure; folds; thrust faults; faults; Phanerozoic
Section Headings: 16 .(STRUCTURAL GEOLOGY)

1003204 80-44482

Mesozoic thrusting in the eastern Mojave Desert, California
Howard, K. A.; Miller, C. F.; Stone, P.
U. S. Geol. Surv., Menlo Park, Calif., USA; Vanderbilt Univ., USA
The Geological Society of America, Cordilleran Section, 76th annual meeting, Corvallis, Oreg., United States, March 19-21, 1980
Geol. Soc. Am., Abstr. Programs 12: 3, 112p., 1980
CODEN: GAAPBC ISSN: 0016-7592
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; CONFERENCE PUBLICATION Bibliographic Level: ANALYTIC
Languages: English
Latitude: N341000; N350000 Longitude: W1150000; W1153000
Descriptors: *California; *orogeny; *faults ; structural geology; extent; displacements ; tectonics; Cordilleran Orogeny; thrust faults; San Bernardino County; United States; Southern California; Mojave Desert; Old Woman Mountains; Mesozoic; Phanerozoic; structure; metamorphic rocks; recumbent folds; folds; nappes
Section Headings: 16 .(STRUCTURAL GEOLOGY)

991126 80-29313

Photoreconnaissance maps showing young-looking fault features in the southern Mojave Desert, California
Morton, D. M.; Miller, F. K.; Smith, C. C.
U. S. Geol. Surv., Misc. Field Stud. Map MF-1051, 7 sheetsp., 1980
CODEN: XMFSDD
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; MAP Bibliographic Level: MONOGRAPHIC
Languages: English
1:24,000; photogeol. maps
Latitude: N330000; N360000 Longitude: W1150000; W1180000
Descriptors: *California; *geomorphology ; structural geology; maps ; neotectonics; photogeologic maps; San Bernardino County; Kern County; Los Angeles County; San Diego County; Imperial County; Riverside County; United States; Southern California; Mojave Desert; faults; displacements; active faults
Section Headings: 16 .(STRUCTURAL GEOLOGY)

988756 80-29322

The role of the Mojave-Sonora megashear in the tectonic evolution of northern Sonora
Anderson, T. H.; Silver, L. T.
Univ. Pittsb., Pittsburgh, Pa., USA
Guidebook, field trip 27; Geology of northern Sonora
Anderson, T. H.(EDITOR); Roldan-Quintana, J.(EDITOR)
Publ: Univ. Pittsb.Univ. Nac. Autonoma Mex.
59-68p., 1979
15 REFS.
Subfile: B
Country of Publ.: Mexico
Doc Type: BOOK Bibliographic Level: ANALYTIC
Languages: English
geol. sketch maps
Latitude: N270000; N360000 Longitude: W1080000; W1140000
Descriptors: *Pacific region ; structural geology ; tectonics; Mexico; North America; Sonora; guidebook; structure; faults; Mojave-Sonora fault zone; Inyo Mountains ; California; United States; Colorado; Sierra Madre; deformation; Mesozoic; Phanerozoic; Cenozoic
Section Headings: 16 .(STRUCTURAL GEOLOGY)

986455 80-22755

Geochemical analyses and geochemical rock sample location map for the Baker-Cypress area, California
Peterson, J.
U. S. Geol. Surv., Open-File Rep. 80-197, 4p., 1980
CODEN: XGROAG
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; REPORT; MAP Bibliographic Level: MONOGRAPHIC
Languages: English
Availability: U. S. Geol. Surv., Open-File Serv. Sect., Branch Distrib., Denver, Colo., United States
1:62,500; geochem. map
Latitude: N350000; N353000 Longitude: W1160000; W1163000
Descriptors: *California; *geochemistry ; surveys ; maps; San Bernardino County; United States; Southern California; Baker; Cypress; Mojave Desert; index maps; geochemical maps; explanatory text
Section Headings: 02 .(GEOCHEMISTRY)

980859 80-20578

Geometric model for Neogene crustal rotations in southern California
Luyendyk, B. P.; Kamerling, M. J.; Terres, R.
Univ. Calif., Dep. Geol. Sci., Santa Barbara, Calif., USA
The Geological Society of America, 92nd annual meeting, San Diego, Calif., United States, Nov. 5-8, 1979
Geol. Soc. Am., Abstr. Programs 11: 7, 470p., 1979
CODEN: GAAPBC ISSN: 0016-7592
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; CONFERENCE PUBLICATION Bibliographic Level: ANALYTIC
Languages: English
Latitude: N343000; N353000 Longitude: W1170000; W1190000
Descriptors: *California; *Pacific Coast; *faults ; structural geology; tectonophysics; systems ; neotectonics; plate tectonics; block structures; Kern County; San Bernardino County; United States; Southern California; Miocene; Neogene; Tertiary; Transverse Ranges; Mojave Desert; Tehachapi Mountains; rotation; right-lateral faults ; left-lateral faults; geometry; crust
Section Headings: 18 .(GEOPHYSICS, SOLID EARTH)

965338 80-06436

Cenozoic volcanism in the Newberry Mountains, San Bernardino County, California
Nason, G. W.; Davis, T. E.; Stull, R. J.
Calif. State Univ., Dep. Geol., Los Angeles, Calif., USA

Cenozoic paleogeography of the western United States
Armentrout, J. M.(EDITOR); Cole, M. R.(EDITOR); TerBest, H., Jr.(EDITOR)
Pacific Coast paleogeography symposium 3; Cenozoic paleogeography of the western United States, Anaheim, Calif., United States, March 15-16, 1979
Pac. Coast Paleogeogr. Symp. 3, 89-95p., 1979
15 REFS.
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; CONFERENCE PUBLICATION Bibliographic Level: ANALYTIC
Languages: English
illus., table, charts, geol. sketch map
Latitude: N344500; N345000 Longitude: W1164000; W1164500
Descriptors: *California; *absolute age; *igneous rocks; *volcanology ; petrology; volcanism; dates; volcanic rocks ; alkali olivine basalt; composition; pyroclastics; San Bernardino County; United States; Newberry Mountains; Cenozoic; Phanerozoic; geochemistry; chemical composition; basalt family; trachyandesite; andesite-rhyolite family; basaltic andesite; dacite; rhyolite; plate tectonics; ratios; Miocene; Neogene; Tertiary; K/Ar; lava flows; clastic rocks; Mojave Desert; lithostratigraphy; Western U.S.
Section Headings: 05 .(PETROLOGY, IGNEOUS AND METAMORPHIC)

963702 80-03765

The early Mesozoic Cave Mountain sequence; its implications for Mesozoic tectonics
Cameron, S.; Guth, P. L.; Burchfiel, B. C.
Mass. Inst. Technol., Dep. Earth and Planet. Sci., Cambridge, Mass., USA
The Geological Society of America, 92nd annual meeting, San Diego, Calif., United States, Nov. 5-8, 1979
Geol. Soc. Am., Abstr. Programs 11: 7, 397p., 1979
CODEN: GAAPBC ISSN: 0016-7592
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL; CONFERENCE PUBLICATION Bibliographic Level: ANALYTIC
Languages: English
Latitude: N343000; N353000 Longitude: W1150000; W1173000
Descriptors: *California; *sedimentation; *metamorphic rocks ; *paleogeography ; structural geology; controls; metasedimentary rocks; Mesozoic ; tectonics; structural controls; lithostratigraphy; San Bernardino County; Aztec Sandstone; United States; Southern California; Mojave Desert; Cave Mountain; lower Mesozoic; provenance; Phanerozoic; quartzite; correlation
Section Headings: 16 .(STRUCTURAL GEOLOGY)

959268 80-02520

Mojave mining memories
Miller, D.
Desert Mag. 42: 7, 20-23p., 1979
CODEN: DSRTBW ISSN: 0011-9237
Subfile: B
Country of Publ.: United States
Doc Type: SERIAL Bibliographic Level: ANALYTIC
Languages: English
illus.
Latitude: N360000; N370000 Longitude: W1160000; W1180000
Descriptors: *California ; economic geology ; gold; silver; Inyo County; United States; ore deposits; history; Panamint Valley; Death Valley National Monument; Randsburg; Mojave Desert; popular geology
Section Headings: 27 .(ECONOMIC GEOLOGY, METALS)

943635 79-24529

Intercalated volcanics and eolian ''Aztec-Navajo-like'' sandstones in Southeast Arizona; another clue to the Jurassic-Triassic paleotectonic puzzle of the Southwestern U.S.

Bilodeau, W. L.; Keith, S. B.

Stanford Univ., Dep. Geol., Stanford, Calif., USA; Bur. Geol. and Miner. Technol. (Ariz.), USA

The Geological Society of America, Cordilleran Section, 75th annual meeting, San Jose, Calif., United States, April 9-11, 1979

Geol. Soc. Am., Abstr. Programs 11: 3, 70p., 1979

CODEN: GAAPBC ISSN: 0016-7592

Subfile: B

Country of Publ.: United States

Doc Type: SERIAL; CONFERENCE PUBLICATION Bibliographic Level: ANALYTIC

Languages: English

Descriptors: *Southwestern U.S.; *Arizona; *paleogeography; *sedimentation; *sedimentary structures; *sedimentary rocks ; stratigraphy; Mesozoic; transport; planar bedding structures; clastic rocks ; wind transport; cross-stratification; sandstone; Aztec Sandstone; Navjo Sandstone; Mount Wrightson Formation; United States; Colorado Plateau; Mojave Desert; California; Santa Rita Mountains; Phanerozoic; tectonics; provenance; volcanic rocks; correlation

Section Headings: 12 .(STRATIGRAPHY, HISTORICAL GEOLOGY)

932573 79-15580

Stress pattern near the San Andreas Fault, Palmdale, California, from near-surface in situ measurements

Sbar, M. L.; Engelder, T.; Plumb, R.; Marshak, S.

Univ. Ariz., Dep. Geol. Sci., Tucson, Ariz., USA; Lamont-Doherty Geol. Obs., USA

J. Geophys. Res. 84: B1, 156-164p., 1979

CODEN: JJGRDA ISSN: 0148-0227 33 REFS.

Subfile: B

Country of Publ.: United States

Doc Type: SERIAL Bibliographic Level: ANALYTIC

Languages: English

Note: Lamont-Doherty Geol. Obs.; Contrib. No. 2750, illus., table, geol. sketch map

Latitude: N341500; N344500 Longitude: W1175500; W1181000

Descriptors: *California; *Pacific Coast; *deformation; *seismology; *faults ; structural geology; tectonophysics; field studies; seismicity; systems ; neotectonics; plate tectonics; strain; seismotectonics; block structures; Los Angeles County; United States; Southern California; Palmdale; San Andreas Fault; Mojave Desert; San Gabriel Mountains; stress; measurement; in situ; instruments; data; earthquakes; active faults; uplifts

Section Headings: 16 .(STRUCTURAL GEOLOGY)