ARIZONA GEOLOGICAL SOCIETY
1979 Spring Field Trip
March 31-April 1, 1979

ROAD LOGS

Tucson to Yuma
Wellton to the Marine Corps Gunnery Range
Yuma to the Silver Bell Mining District
Martinez Lake Turnoff to Quartzsite
Quartzsite to Buckeye

Note: Road logs will be published in Arizona Geological Society Digest 12. We urge you to contribute any additions or corrections to these logs. Deadline is May 1, 1979. Contact Digest editors or an AGS officer.

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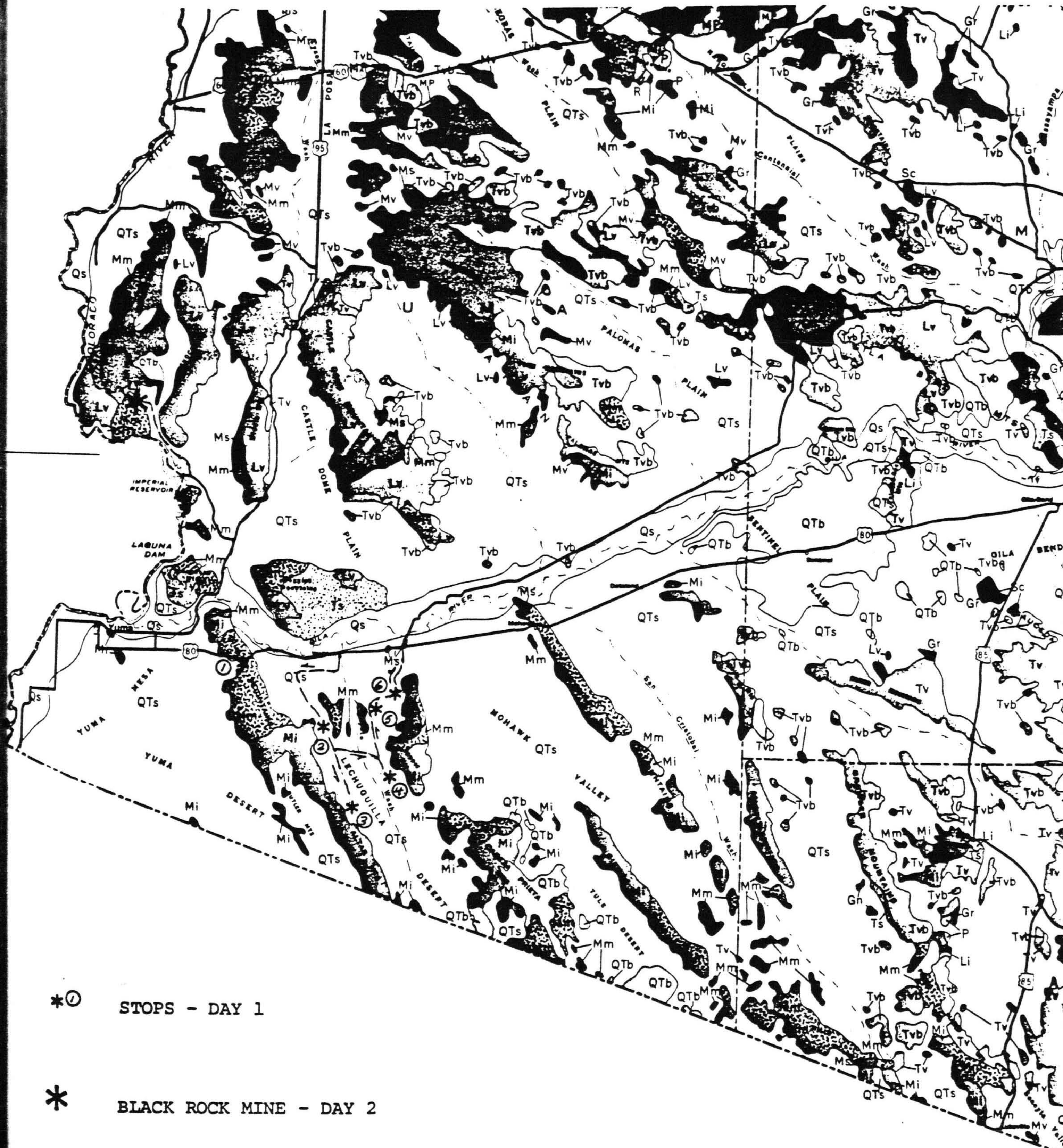
Arizona Geological Society

1979 Spring Field Trip



*① STOPS - DAY 1

* BLACK ROCK MINE - DAY 2

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PRELIMINARY GEOLOGIC ROAD LOG
Interstate 10 and 8
Tucson to Yuma

Author's note: This is "first draft" copy of the road logs to be submitted for publication in Digest 12. Numerous omissions have been noted and any suggestions the reader might have for improving this log will be gratefully accepted and acknowledged. No quotations for reference purposes may be made from this draft copy.

Dan Lynch

TUCSON MOUNTAINS AND CATALINA MOUNTAINS TO MP 240

Pusch Ridge and the fore-range of the Catalina Mountains lie to the north of this section of freeway. Details of structure are easily seen from the road while traveling northwest. Layering of the Catalina Gneiss is warped into a broad anticlinal structure which is seen to plunge gently to the west. Opposing dips on the limbs are most easily observed from the north section of road. The rocks of Pusch Ridge are alternating layers of dark, biotite augen-gneiss and light colored muscovite granite. Although all of the K/Ar ages from these rocks fall within the Cenozoic, the rocks were formerly thought to be older Precambrian with their argon clocks reset by a mid-Tertiary thermal event. Recent work (Reynolds, pers. comm.) suggests that dark layers are mylonitized Oracle granite and the light layers are 50 million year old granite sills intruded and then mylonitized by the event which created the Tortolita-Catalina-Rincon metamorphic core complex.

As you proceed past the end of Pusch Ridge, the erosional amphitheater developed on the Catalina Granite will come into view. Intrusion of this pluton 25 m.y.a. was probably responsible for resetting the argon clocks.

To the west of the freeway are the less spectacular Tucson Mountains, a complex series of intrusions and lava flows resting on Cretaceous rocks. Rocks of the southern end are rhyolites and monzonites which have radiometric ages ranging between 50 and 72 m.y., within the time span of the Laramide Orogeny. "A" Mountain and Tumamoc Hill, directly west of Tucson, have a well exposed section of mid-Tertiary lava flows interbedded with volcaniclastic and sedimentary rocks which range in age from 27.6

± 1.2 m.y. (Turkey Track porphyry) to 23.7 ± 0.5 m.y. (the basaltic andesite which caps Tumamoc Hill) (Eastwood, 1971; Phillips, 1976, Shafiqullah, et al., 1978).

The Safford Peak group, which lies beyond Ina Road, contains a coarse conglomerate which rests unconformably on Cretaceous rocks. This is one of the oldest units of the widespread conglomerates covering southern Arizona having an age of 39.4 ± 1.3 m.y. determined on an andesite flow contained in the sequence. The ridges of this mountain group are formed of 28.5 ± 1.9 m.y.o. andesite and Safford Peak, the highest point, is made of a 25.1 ± 0.9 m.y.o. dacite intrusion. (Ages from Eastwood, 1971.)

RILLITO RIVER, MP 249

The Rillito River and streams tributary to it are the major drainages for the northern Tucson basin as well as the eastern and southern slopes of the Catalina and Rincon Mountains. Cienega Creek rises in the Sonoita valley east of the Santa Rita Mountains and flows northward to join Pantano Creek in Cienega Pass. Pantano Creek joins the Rillito River northeast of Tucson, and the Rillito joins the Santa Cruz River a few hundred meters west of this bridge. The map shows that the Tucson basin is drained by rivers which flow around its periphery rather than down the center of the valley.

CANADA DEL ORO WASH, MP 247

This creek flows southward out of Canada del Oro, a graben-valley which separates the high Catalina mountains on the east from the lower Tortolita mountains on the west. The Pirate fault on the eastern margin of this graben is exposed while the western fault positions were determined by gravity survey (Budden, 1975). The Tortolita mountain front is old and deeply pedimented while the Catalina mountain front is not. Most of the sediment being carried by the modern stream systems comes from the Catalina mountains (McFadden, 1978).

RILLITO (CEMENT PLANT), MP 240

The Portland Cement company makes cement out of lower Paleozoic rocks quarried from Twin Peaks (visible to the southwest - 8:00 o'clock). Several low, isolated bedrock hills can be seen at 1:30. They are composed of altered quartzite, possibly Apache group, separated by a fault from Oracle(?) granite at a depth of 80 m. Four drill holes spaced 300 m in cardinal directions from the outcrop hole encountered the granite beneath alluvium at depths ranging from 50 to 120 m, without passing through the altered quartzite. This suggests a buried pediment having a general slope to the southwest beneath this area.

MARANA AIR PARK ROAD - PINAL COUNTY LINE, MP 232

Ragged Top, a mountain with a distinctive irregular skyline, is at 9:00. Biotite from the Ragged Top Rhyolite has a K/Ar age of 25.6 ± 1.0 m.y. (Eastwood 71). The hill at 1:30 is composed of gneiss. Owlhead Butte north of the Tortolita Mountains is at 3:00. Directly ahead is Picacho Peak to the left of the highway and the Picacho Mountains to the right.

RED ROCK ROAD, MP 225

Northward from this point, the view is increasingly dominated by Picacho Peak. It has the classic shape of an exhumed volcanic neck but it is actually a fault-bounded block from the flank of a volcano. Although the flow units cannot be easily differentiated, apparent dips to the right (northeast) can be seen in some planar elements of the rocks. The structural complexity of this peak is typified by the unexplained 50-meter-long block of Oracle Granite found near the summit.

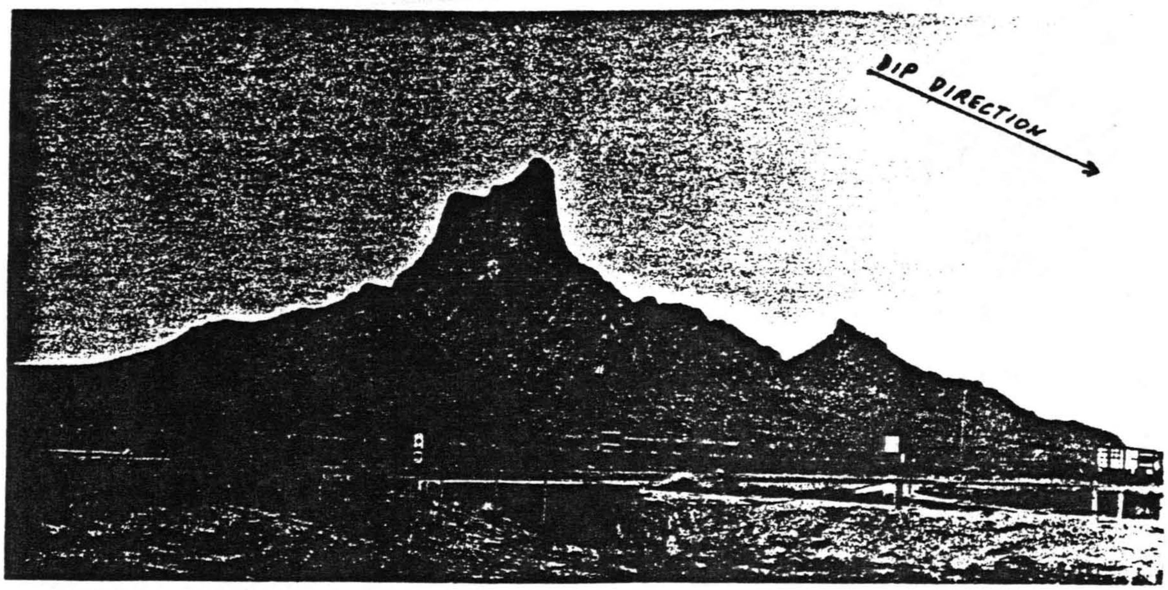


FIGURE 1. PICACHO PEAK. Apparent dip of planar elements in the lava flow sequence is parallel to the "dip direction" line. A coherent block of Oracle Granite underlies the concave slope to the left of the summit.

Three isolated mounds of black-appearing rock occur in the pass and are best seen from near the interchange. The most distant outcrop of this rock lies atop a gneissic ridge extending southeastward from the Picacho mountains and may not be easily located. This dark red, aphanitic trachyte is the most potassic of the alkaline rocks of Picacho Peak having a K_2O content of 12.5%. All the other trachytes and trachyandesites have combined alkali contents over 7.5% and many of the units are ultrapotassic (K_2O/Na_2O greater than 10). The ultrapotassic trachytes are auto-brecciated, having fractured during the last stages of flow movement. This dark red to purple color and pervasive auto-brecciation are characteristic of other ultrapotassic rocks in the state.

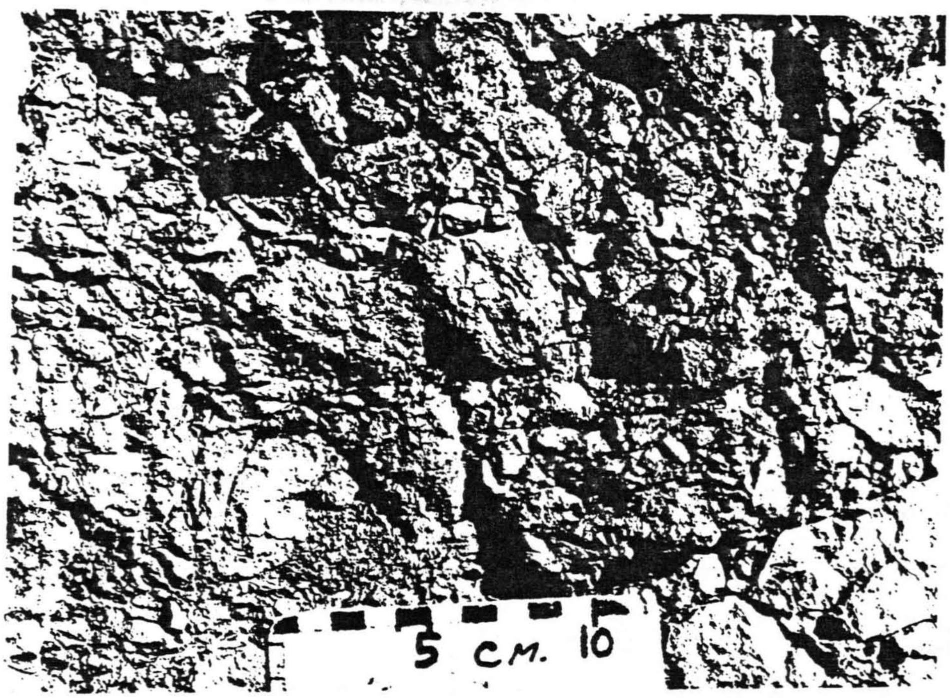


FIGURE 2. AUTO-BRECCIATED ULTRAPOTASSIC TRACHYTE AT PICACHO PEAK.

Four K/Ar dates between 22.2 and 22.6 m.y. have been determined on lava flows from the peak massif. The ultrapotassic trachyte is 20.7 ± 0.5 m.y.o. (Shafiqullah, et al., 1976).

The Picacho Mountains north of the pass are composed in their southern half of gneiss which resembles Catalina Geniss. This rock has not been studied in detail. The northern half is granite of a probable Laramide age.

EARTH FISSURE, MP 216

A large earth fissure, striking parallel to the Picacho Mountain front, crosses the highway and railroad at this point. The Picacho basin has dropped more than a meter since 1951 when the cracking began. Subsidence of the Picacho basin is attributed to compaction of sediments upon withdrawal of ground water but the site of ground breakage is probably close to the eastern basin margin fault. Highway and railroad crews must make repairs every few months.

The Exxon exploratory drill hole is about 10 km north of here. The hole is 3100 m (10,100 ft) deep. A bed of halite 25 m thick was encountered at a depth of 650 m (1200 ft) and an additional 1830 m (6000 ft) of anhydrite with shale stringers lies beneath the halite. A volcanic unit at a depth of 2800 m (9700 ft) is trachyte related to the Picacho Peak rocks and has a K/Ar age of 14.66 ± 0.34 m.y. (Shafiqullah, et al., 1976; Peirce, 1976).

INTERSTATE 8 TO YUMA, KEEP RIGHT - Mileposts change

Road passes north of the Arizola Mountains which are composed of gneiss. Does anybody out there know more about this rock?

REST AREA, MP 177
SANTA CRUZ WASH, MP 170.5

North of the Tucson Mountains, the Santa Cruz river becomes much less well defined. Major flood discharges passing through Tucson spread out in these broad basins and either sink into the sediment or evaporate. Dumps of the Sacaton mine can be seen at 3:00 across the valley.

SANTA ROSA WASH, MP 163

From here, the road climbs the alluvial surface to the Vekol mountains. The upper reach of this surface is a pediment developed on granite bedrock. To the south of the road, mid-Tertiary basalt flows, partially eroded, lie atop alluvial fan deposits which have been mostly removed. On basalt-capped Table Top Mountain, as well as the promontory northwest of it, the basalt is separated from Precambrian Apache group by several meters of alluvium.

OUTCROP, MP 149

The Precambrian granite in this outcrop is almost completely weathered to gruss. The relief on this old surface is preserved beneath the basalt that covers it.

BASALT OUTCROP, MP 145

This basalt is designated on the state map as Quaternary basalt, as is the basalt which covers the crest of the San Tan mountains to the southwest. Both are obviously much older but have not been radiometrically dated.

OUTCROP, MP 141

Note the baked zone beneath the basalt above the fanglomerate.

GILA BEND TURN OFF, MP 119 - DO NOT EAT HERE!!!

INTERSECTION OF STATE HIGHWAY 85

A road log for this route through Ajo to Lukeville and from Why to Tucson along State Highway 86 by Stanton B. Keith has been published by the Arizona Bureau of Geology as Bulletin 183.

PAINTED ROCK ROAD INTERSECTION, MP 102

A broad, low basalt cone is located directly south of this intersection at 9:00. This easternmost volcano of the Sentinel Peak volcanic field is typical of cones of this field with its extremely low aspect ratio (height to width).

PAINTED ROCK MOUNTAINS AND SENTINEL PEAK VOLCANIC FIELD, MP 99

Rocks of the Painted Rock Mountains closest to the highway are auto-brecciated ultrapotassic trachyte flows cut by trachyte dikes. (Cretaceous andesite on the map.) A fine-grained latite(?) intrusion covered by trachyte and alkali rhyolite ash-flow units occupies the northern part of the range.

The highway crosses basalt flows from here to MP 80. The flow units are thin and all of the source cones, except for Sentinel Peak, are so subdued as to be nearly impossible to identify from the highway. The thin lava flows which cover such a wide area and the low cones around source vents suggest basalt of low viscosity. Gas content of this lava may have been so low or able to escape so easily that cinder and agglutinate, which forms steep cones around source vents in the other Arizona volcanic fields, did not form here.

The flows lie atop well sorted sediments deposited by the Gila River prior to 3 m.y.a. The river now flows through a gap between the northern Painted Rock Mountains the Gila Mountains and has cut a channel through the basalt into the underlying sediments.

REST AREA, MP 85

This rest area is constructed on a basalt flow giving an excellent opportunity to examine the surface. Some festoon flow banding can still be seen in the air photos of these flows. All of the smaller flow-top features have been eroded away leaving a lag surface of basalt cobbles.

The closest mountain range to the southwest is the Aztec Hills. This rock is identified as MZgr on the state map and lumped with the Gunnery Range Batholith. These rocks have not been investigated in detail but their lithology is different from the Gunnery Range granite.

Directly south of this rest area can be seen the broad basalt mesa of the northern Aguila Mountains. The Mesa is capped by a series of 3 to 5 meter thick basalt flows which dip about 5° to the north. This surface is broken by closely spaced normal faults which strike parallel to the regional structural grain. They can be easily traced into an older andesite-latite volcanic center south of the mesa. This basalt is identified as Quaternary on the map but is probably in excess of 10 m.y.o. The volcanic center to the south, labeled Cretaceous, is probably mid-Tertiary and contemporary with the silicic volcanic rocks of the Ajo area.

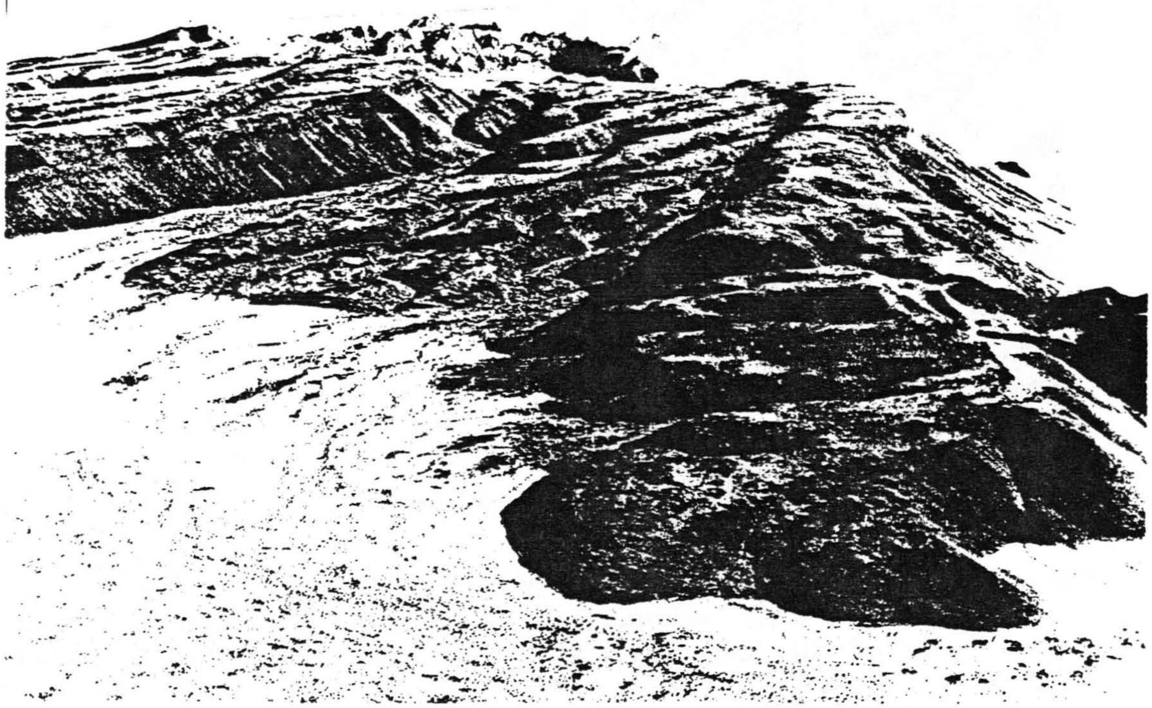


FIGURE 3. FAULTED AND DISSECTED SURFACE OF THE NORTHERN AGUILA BASALT MESA. The older volcanic center can be seen beyond the far end of the mesa. (Bill Tucker photograph.)

AZTEC, MP 74

Beyond Aztec is the San Cristobal valley. The Air Force M-X missile test trench is on the west side of this valley next to the Mohawk Mountains.

DATELAND AIR FORCE STATION FOUNDATIONS, MP 68

SAN CRISTOBAL WASH, MP 60

FIGURE 4. EASTERN FLANK OF THE MOHAWK MOUNTAINS SEEN FROM THE SOUTH. The line which defines the mountain front by connecting the ends of the spurs appears straight but the actual mountain front is embayed by pedimentation and is quite sinuous. This mountain front is no longer tectonically active. (Bill Tucker photograph.)

MOHAWK MOUNTAINS ROAD CUTS, MP 54

Precambrian gneiss is exposed in this road cut. Tops of the Mohawk Sand dunes can be seen from the western slope of this range.

<u>TACNA INTERCHANGE, MP 42</u>

The dark hills located both north and south of here are composed of mid-Tertiary sedimentary rocks which will be examined in detail in the Baker Peaks area south of the freeway.

<u>WELLTON INTERCHANGE, MP 31</u>

Day 1 field trip departs from here to the south.

North of Wellton are the Muggins mountains, site of uramium exploration. Bones of a Miocene(?) camel <u>Stenomylus arizonesis</u> were collected from a site 6 miles northeast of Wellton (Wood, 1956).

<u>REST AREA, MP 22</u>

Jump the fence and examine the fine-grained sediments.

<u>GILA MOUNTAINS, MP 21</u>

The rock here is described as Mesozoic on the state map. Eldred Wilson thought its metamorphism was related to emplacement of the granite to the south which he considered to be Mesozoic. Two K/Ar ages on biotite separates from this gneiss (199 and 319 m.y.) are wildly discordant and obviously reset (Eberley and Stanley, 1978). Careful observation of the rock in the vicinity of MP 19 shows it to be an angular fanglomerate with a red matrix and containing diabase dikes, rather than being solid gneiss. At milepost 18, younger fanglomerate of similar clast size and shape but lacking the red matrix is exposed for comparison.

Beyond mile post 17, the freeway crosses the Plain of Yuma to the Colorado River terraces in Yuma. The hill in the far distance is Pilot Knob in California. Zircon Pb dates of around 1700 m.y. have been reported. for this rock. Knobs of granitic rock in Yuma which are described on the map as being part of the Gunnery Range Batholith (MZgr) are of entirely different lithology. Eberley and Stanley (1978) report a K/Ar age of 39.5 m.y. but a zircon Pb age of about 1700 has been reported showing this rock to be related to the rocks of Pilot Knob.

<u>YUMA</u>

WELLTON INTERCHANGE, BEGIN DAY 1, DIRT ROAD LOG, MP 31 -- by Dan Lynch

NOTE: This road log covers features located on the U.S. Air Force Gunnery Range R2301. Permission to enter this range must be gained in writing from the Commandant, U.S. Marine Corps Air Station, Yuma. Although this part of the range is used primarily for computer-scored air-to-air fighter tactics and ground access to civilians is easy to obtain, the range may occasionally be closed for live firing exercises and aircraft will sometimes use this area to jettison live bombs in an emergency. Don't pick up anything that looks like military hardware while on the range.

	miles	miles cumulative
Cross Wellton Interceptor canal, begin mileage count		0
Road turns to cross levee, stay on main road.	1.5	1.5
Buildings on left (if not, you're lost - go back to levee)	1.0	2.5
T intersection at 14th street, turn right (west)	0.4	2.9
T intersection at Camino del Diablo, turn left (south) The Gila mountains are to the west and south, Wellton Hills to the east-southeast.	4.0	6.9

ENTER GUNNERY RANGE HERE

Low, gneiss insulbergs, stone building, road intersection to right	1.0	7.9

The insulbergs project from a broad pediment which extends northward from the foot of Sheep Mountain (see topographic map). The Sheep Mountain scarp is easily seen south of this place. It lies behind the dark hills with the prominent white pegmatite veins which can be reached by this road. All of the visible bedrock here is Precambrian gneiss and schist. Schenker (1977) divided the thin alluvial cover into 4 units based on their surface appearance and other geomorphic criteria. Q-1, the oldest, is a poorly sorted fanglomerate which is now deeply dissected and lacks terraces. It is probably on the order of a million years old and may represent deposits from the last pulse of tectonic activity in the area. Q-2 and Q-3 alluvium fills the valleys cut into Q-1. Q-2 is an older alluvium with well developed "B" soil horizons indicative of deposition in a humid, cool climate, perhaps during the latest glacial event. The three Q-2 terraces identified represent individual surfaces of aggradation in interpluvial periods of reduced rainfall and, perhaps, higher temperatures.

Q-3 is bar and swale alluvium having an arid soil profile with a calcium carbonate horizon. Four sub-units of Q-3 have been mapped on the basis of their desert varnish and

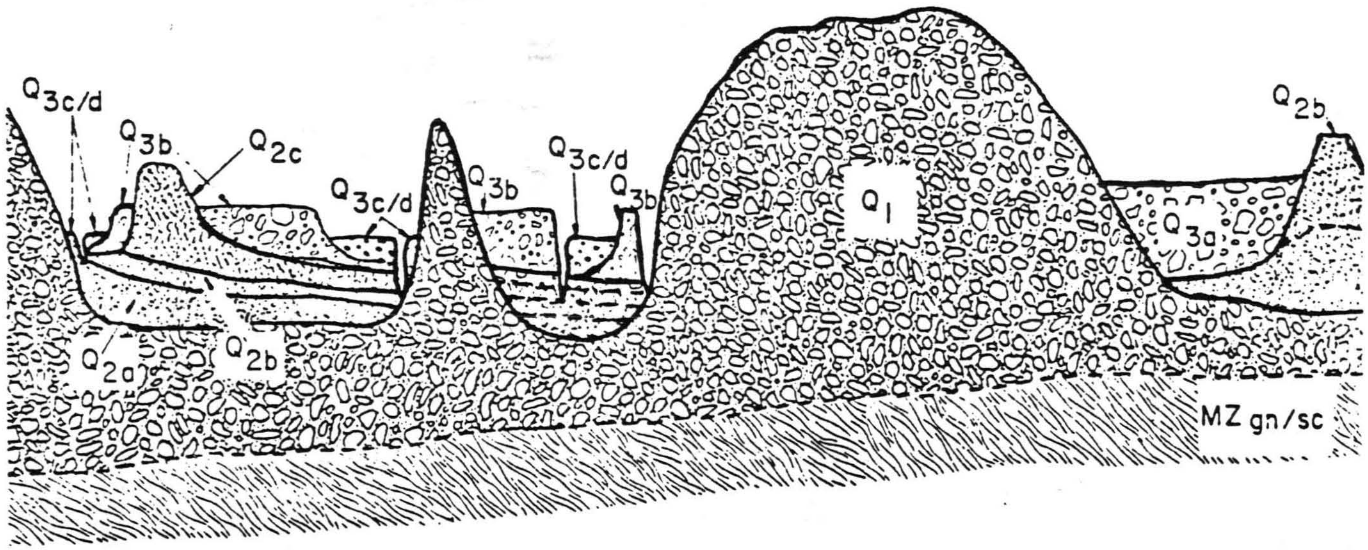
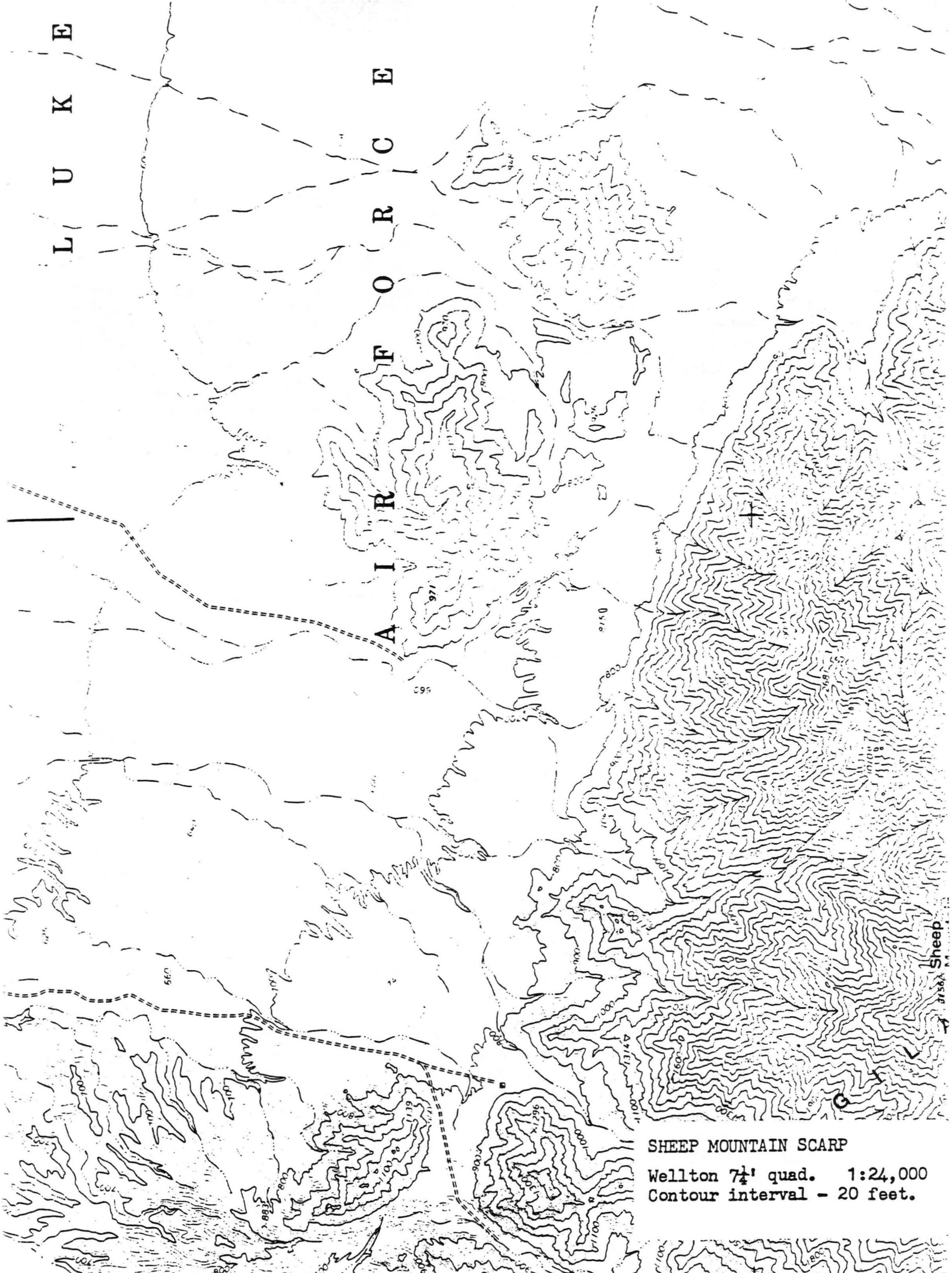


FIGURE 5. ALLUVIAL UNITS ON THE PEDIMENT NORTH OF THE SHEEP MOUNTAIN SCARP (from Schenker, 1977).

	miles	cumulative
thickness of carbonate layer. Q-4 constitutes the most recent stream deposits and it lacks both soil development and desert varnish. The road beyond these insulbergs crosses a broad sheet wash plain of Q-4.		
Power pole next to road - mileage check	4.1	12.0
STOP # 1, VIEW SHEEP MOUNTAIN SCARP TO WEST	1.5	13.5

The Sheep Mountain Scarp shows many of the characteristics of an active mountain front including the linear base, triangular facets on the ridges and steep alluvial cones at the mountain front. However, this scarp is not developed along an active mountain front fault but rather along a shear zone which is parallel to the contact of the Gunnery Range batholith about 4 km to the south. Traverses across the shear zone show mylonite-gneiss with foliation parallel to the zone but no fault. The shear zone can be followed into the Gila mountains to the west where it becomes broader and disappears within a few kilometers of the mountain front. This scarp has resulted apparently from relatively recent erosion along a structural weakness of Laramide age.



SHEEP MOUNTAIN SCARP

Wellton 7¼' quad.   1:24,000
Contour interval - 20 feet.

FIGURE 6. SHEEP MOUNTAIN SCARP. The straight mountain front, triangular facets and alluvial cones can be seen in this view. Schenker's Q-1 alluvium forms the dissected surface in the foreground.

South of this scarp is the contact between the light colored Gunnery Range granite and the dark colored Precambrian gneisses. Unpublished K/Ar ages determined on biotite from this granite correspond to the end of the Laramide orogeny

	miles	cumulative
between 50 and 55 m.y.a. These are probably cooling ages. A single uranium-lead age (Lee Silver rumor date) of about 80 m.y. for this rock was seen on a transparency projected at a GSA meeting.		
Good road turns to the right toward the Air Force Test station, go straight ahead.	1.8	15.3
Road intersection. This road is dragged periodically to detect footprints of illegal aliens walking up the valley. We will return to this point. Copper mountains 9:30-10:30, Cabeza Prieta mountains 10:30-11:30, Raven butte 1:00.	0.9	16.2
Road to right (west) leads to Cipriano Pass	3.0	19.2
Road to right - turn off to Raven Butte. The tracks are prominent, do not drive on the desert surface beyond the tracks because the damage is long lasting.	2.2	21.4
STOP #2, BASE OF RAVEN BUTTE	2.9	24.3

Raven Butte, as seen from a distance, appears to be a large basalt plug. Its shiny black surface contrasts markedly with the tan-white granite which forms the mountain west of it and the desert floor around it. Less than a quarter of its bulk is basalt, the rest is an armor of basalt boulders covering granite slopes beneath. This stop is near the south ridge, the only place where this armor is stripped away to expose the internal structure.

Granite bedrock forms the lower part of the pedestal. Gruss alluvium containing rounded granite boulders up to 1 m rests on the bedrock pedestal and separates the granite from the basalt. Although this depositional contact is exposed only in this place, for a total length of 5 m, the rest of the butte suggests that this contact is either a buried pediment or a surface of low relief. The gruss above probably represents a mountain front alluvial fan.

The lowermost lava flow rests on and preserves the old fan surface. Another 2 m of gruss alluvium above this lava flow indicates no change in the depositional environment after its eruption. Nine more flows cover this thin layer of alluvium without break. Lack of alluvium between the flows may indicate insufficient time between eruptions or a change in the depositional environment, possibly due to the accumulation of lava on the fan surface.

Raven Butte is joined to the Tinajas Altas mountain massif by a sharp granite ridge. A fault zone is located a few meters to the west of the lowest basalt outcrop.

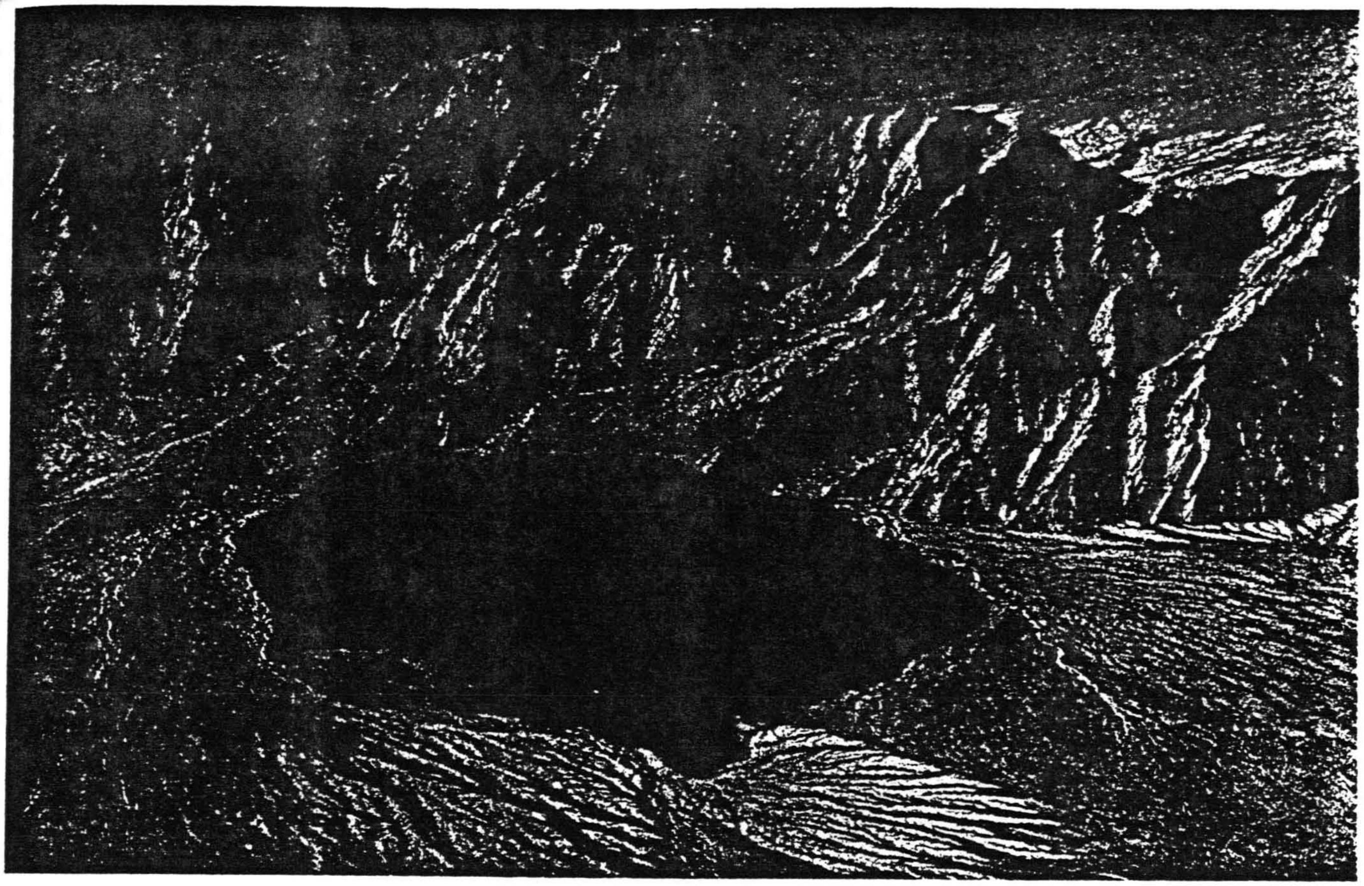
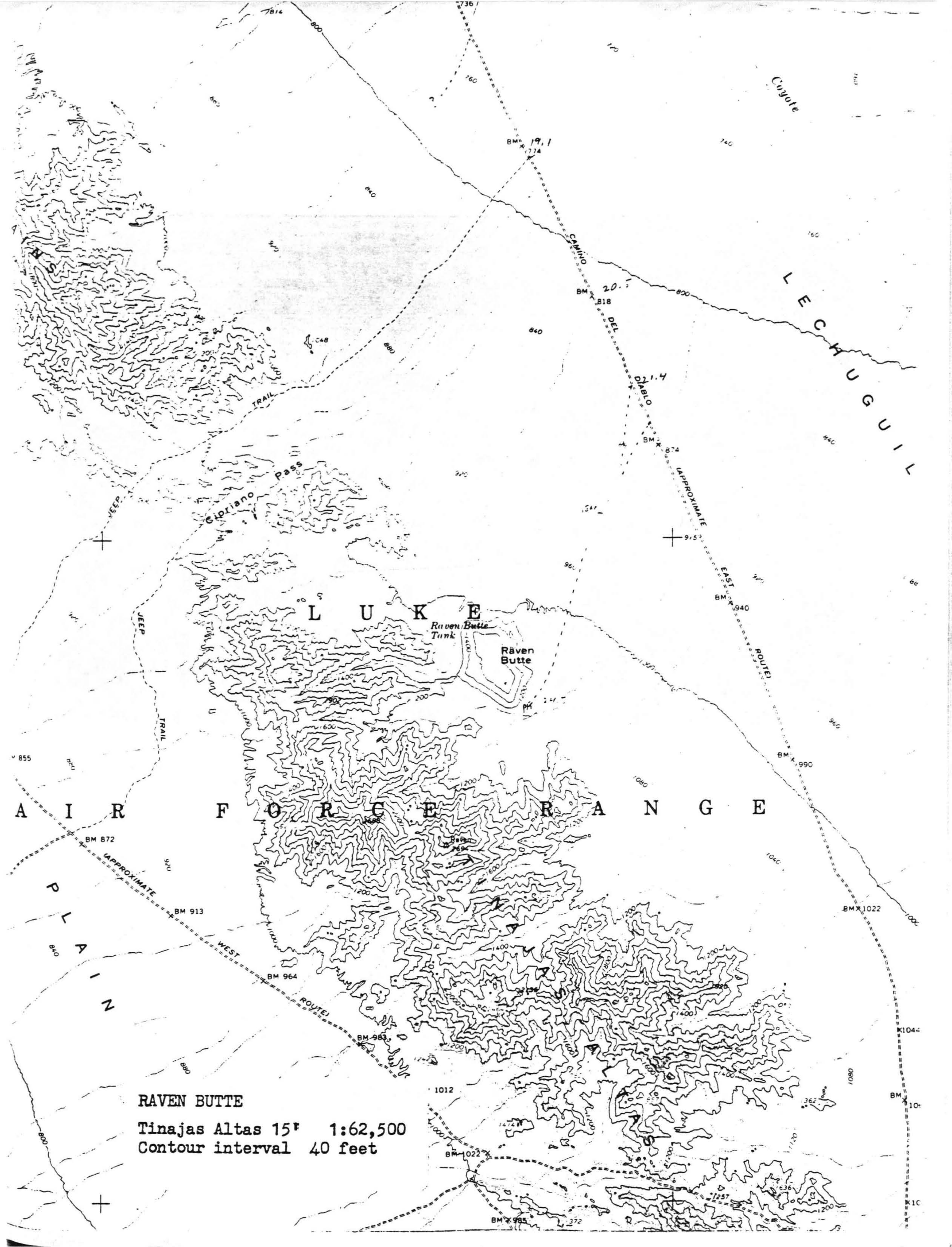


FIGURE 7. RAVEN BUTTE. The appearance of great flow thickness results from a basalt-boulder armor covering the lower slopes. A step block can be seen on the east side where the flows have slid down 110 m. The break is on a line connecting the easternmost spurs of the mountain range which may correspond to the valley margin fault. The hummock of debris at the base of this block suggests that it may be a simple landslide block and may not be related to basin and range faulting.

The basalt armor consists of boulders weathered out of the massive centers of the flows. These boulders are nearly free of internal stresses as evidenced by the extreme difficulty encountered in attempting to break one open. They are attacked only by surficial weathering, which gives them a very long life in this arid environment.

Numerous basalt covered hills akin to Raven Butte are found in this desert. Three of them may be easily seen to the



RAVEN BUTTE

Tinajas Altas 15' 1:62,500
Contour interval 40 feet

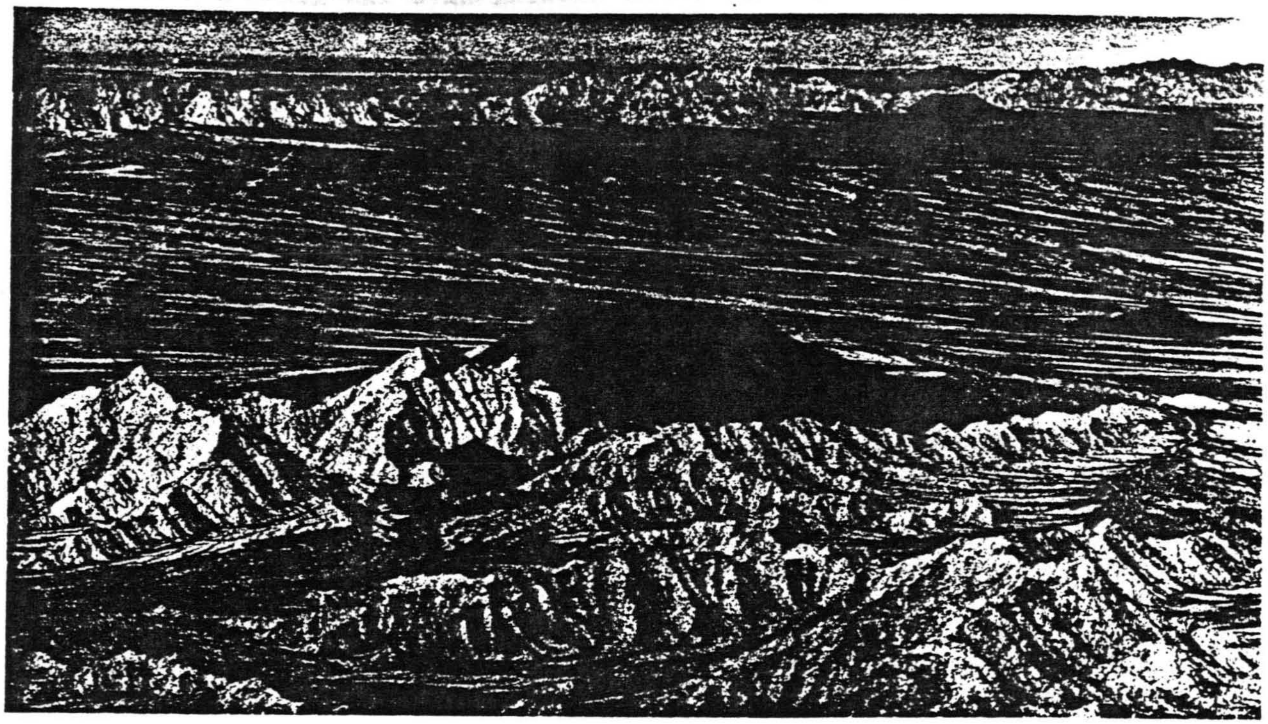


FIGURE 8. TORDILLO MOUNTAIN. This mountain and the basalt remnant north of it are features similar to Raven Butte, seen in the far background. In this part of the Cabeza Prieta Mountains, filling of these arid climate erosional features is more obvious than at Raven Butte.

southeast of Raven Butte, the largest being Tordillo mountain. Raven Butte is the only one which is almost completely boulder armored, the others exhibit their internal structures much more clearly. Each has buried a remnant of desert identical to that surrounding them. In addition, other desert geomorphic features have been buried by andesite lava flows in the Cabeza Prieta Mountains. Lynch has inferred that arid climatic conditions similar to those active today were characteristic of this region at the time of eruption 10 to 17 m.y.a.

Geomorphic aspects of equigranular granite weathering in an arid environment are well illustrated in the vicinity of Raven Butte. The irregular nature of the mountain front with its many re-entrants shows it to be an inactive front. Mountain slopes meet the flat desert floor at a sharp angle over most of the front save where major drainages exit from the mountains. This results from surface weathering of the granite

	miles	cumulative
into small grains. Violent rainfalls from convective storms sweep the slopes carrying the detritus to the desert floor where the flow spreads out distributing the detritus.		
Intersection with Camino del Diablo turn left (north)	2.9	27.2
Intersection with cross valley road, turn right (east) Copper mountains directly ahead, Wellton Hills 9:00, Raven Butte 3:00, Cabeza Prieta Peak 1:30.	5.3	32.5
Coyote Wash, west branch	2.0	34.5
Coyote Wash, main channels Coyote wash is the main drainage in the Lechugilla valley.	0.3	34.8
It is an anastomosing channel system in the nearly horizontal center of the valley where the western channel drains the west side and the eastern channel drains the east side with few clearly defined connections between the two channel systems.		
WRECKED AIRCRAFT IN THE ROAD. This is a private aircraft, not a military crash site. Guess how it got here.	0.7	35.5
Road intersection	2.0	37.7

CONTINUATION OF ROAD LOG -- by Rich Lundin

Beginning of road log.	0.0	37.7
Biotite gneiss intruded by pegmatites in stringers. Schlieren noted in the gneissic fabric with an orientation to the northwest.	0.7	38.4
View to the northwest of gold-silver prospects along the contact of the granite-biotite gneiss and later pegmatite dikes. The dikes are visible along the ridge line and are iron stained so as to show a color contrast. According to S. B. Keith (1978) metal production from these prospects has been small.	5.0	43.4
Stop to look at pegmatites in biotite-granite gneiss.	0.7	44.1

	miles	cumulative
Stop to look at mineralization and rock types at the Poor Man mine (see S. B. Keith, 1978, for description).	0.9	45.0
Leave Wellton Hills	0.2	45.2
Intersection with main road to Gunnery Range. Wellton-Mohawk Canal on right.	3.7	48.9
Cross Wellton-Mohawk Canal.	0.2	49.1
Turn east onto Interstate 8.	0.6	49.7
Exit from the Interstate at the Roll exit.	7.0	56.7
Intersection of Roll exit at Avenue 35-E. Antelope Hill outcrops of mid-Tertiary sediments similar to those at Baker Tanks to the north. Go south on marked and flagged dirt road.	0.5	57.2
Continue straight ahead on marked and flagged dirt road.	1.1	58.3
Continue to the left fork on marked and flagged dirt road.	0.9	59.2
Outcrops on east side of road are arkose with large clasts of granitic and gneissic material.	1.0	60.2
Cross wash.	0.2	60.4
Well developed pediment surface.	0.1	60.5
Take right fork of road. Granite gneiss in outcrop.	0.5	61.0
Baker Tanks Pavillion. Stop to look at arkosic material with large granite and granite-gneiss clasts. Note bedding relationships. What is the type of deposition involved in the formation of these units? And how do you get such large clasts in such a fine-grained groundmass? These units are considered Tertiary-Cretaceous (Paleocene?). This environment of deposition predates known uranium mineralization in the Muggins Mtns area which is thought to be Miocene. These units have short lateral extent and the material appears not to have traveled very far and is close to a source.	0.8	61.8
Hypabyssal fanglomerate. Note the relationships between this outcrop and the previous outcrops. End of Day 1. Return to Yuma for poster session.	1.0	62.8

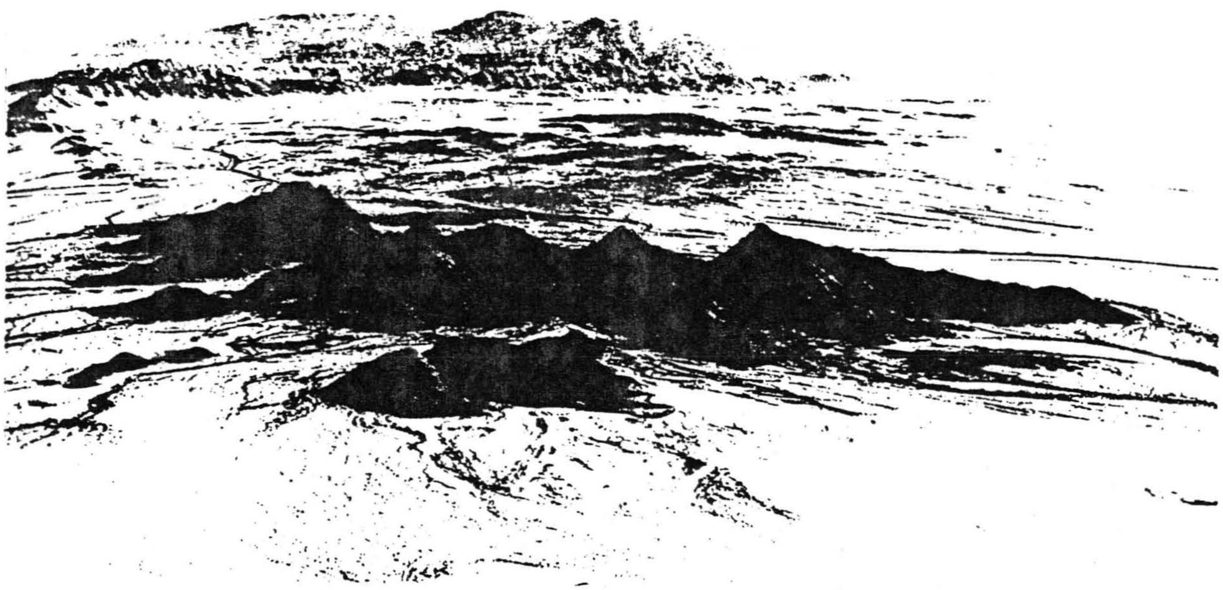


FIGURE 9. EXHUMED PEDIMENT SOUTH OF BAKER PEAKS. Baker Peaks (in the foreground) are composed of the sedimentary rock to be examined in the last stop. Copper Mountains are beyond the pediment to the south.

FIGURE 10. KINTER(?) FORMATION AT BAKER TANKS. Large, rounded boulders of gneiss and granite are contained within a well sorted arkosic sandstone matrix.

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<u>Second Day</u>

Road Log from Yuma to Black Rock Mine, Silver Mining District

by

Peter H. Dohms, John E. Teet, Peter Dunn

Distance: 43.7 miles

Starting Time: 7:30 AM

Assembly Point: Caravan facing north on east side of Araby Road at intersection with west entrance to Arizona Western College. 0.6 Miles N. of Araby Road interchange of Interstate 8 (Exit 7). Bring your own lunch.

0.0 Assembly Point - on alluvial Yuma Mesa south and above the intense agricultural development surrounding the Gila and lower Colorado Rivers. Drive north.

1.0

1.0 Turn right onto U. S. Highway 95.

1.5

2.5 North entrance to Arizona Western College.

3.2

5.7 Cross Gila Gravity Main Canal. The aroma is <u>not</u> from Orange Blossoms.

1.3

7.0 Laguna Mountains at 12:00 - Precambrian complex.

1.7

8.7 United Metro gravel pit on right, Yuma County pit on left.

0.6

9.3 Small outcrops of Precambrian - outliers of Laguna Mtns. Entering Gila River Valley.

0.4

9.7 Wellton-Mohawk Irrigation Project Canals. Large canal carries fresh water east (upstream). Small canal carries brackish waste water west (downstream) to site of Bureau of Reclamation's desalting plant. Eventual destination of this water is Mexico.

0.3

10.1 At 10:00 -- McPhaul Bridge, 1 lane suspension bridge over Gila River, now closed.

0.4

10.4 Precambrian of northern Laguna Mtns. visible at 9:00.

0.2

10.6 Gila River bridge, white and blue herons occasionally visible in pools during periods of low water.

0.5

11.1 9:00 - 12:00, Northern Laguna Mountains, several small gold prospects in shear zones.

1.4

12.5 Castle Dome peak visible at 12:00.

1.2

13.7 Enter Yuma Proving Ground, Muggins Mountains at 3:00.

2.1

15.8 Main entrance to Yuma Proving Ground, 155 mm and 208 mm cannons.

2.7

18.5 <u>TURN LEFT</u>. Signs point to Martinez Lake Recreation Area, Imperial National Wildlife Refuge.

2.2

20.7 Airfield at 9:00. Facility of Yuma Proving Grounds.

0.2

20.9 Intersection - take right fork (straight).

1.6

22.5 Chocolate Mountains (Calif.) at 9:00. Phillips Parachute drop zone at 3:00.

1.5

24.0 Trigo Mountains at 12:00.

1.7

25.7 Miocene (?) volcanics 9:00 - 11:00.

1.3

27.0 Note sign on right!!

0.6

27.6 Leave Yuma Proving Ground. Towns of Fishers Landing (10:00) and Martinez Lake (12:00 - 2:00) in view.

1.1

28.7 TURN RIGHT onto gravel road, collection point, parking. Consolidate into as few vehicles as possible.

1.0

29.7 Martinez Lake at 9:00. Little Picacho Peak, Calif. at 1:00. Note alluvial terrace over which we are driving.

1.1

30.8 JUNCTION. TURN RIGHT on road marked "Red Cloud Road".

0.7

31.5 Enter Imperial National Wildlife Refuge. 25,000 acre migration rest stop for ducks and geese. Make note of regulations concerning permitted activities.

0.3

31.8 JUNCTION, continue straight ahead on 1 lane dirt road. Wide road to left goes to Refuge Headquarters and Meers Point Campground.

1.5

33.3 Tertiary (Miocene?) volcanics at 3:00. Note relationship with terrace gravel.

0.7

34.0 Note picturesque volcanics - tuffaceous and pyroclastic material.

0.5

34.5 Enter SE corner of Picacho, Arizona-Calif. 7½ minute Quadrangle near S. side of Sec. 35, T 4 S, R 22 W.

0.4

34.9 Steep narrow roadcut in soft pink pyroclastic volcanics.

0.9

35.8 "Tunnel of trees" - entering Yuma Wash. The thick brush provides an impediment to the occasional flash floods down Yuma Wash with flows becoming constricted and coursing along the road. Note elevations of some of the flood debris in the brush alongside the road.

0.2

36.0 Road to Clear Lake goes to left. Last access to River. A side trip in here (0.2 mi.) would provide a good opportunity to study the interface between severe desert and riparian geomorphology and lifeforms.

0.4

36.4 Boundary - Leave Imperial National Wildlife Refuge. Reenter Yuma Proving Ground. Periodic warning signs advise of presence of unexploded ammunition east (3:00) of road). Note outcrop of Precambrian complex at 9:00.

0.3

36.7 Small outliers of volcanics. Yuma Wash closely follows a generally N-S contact separating Precambrian on the west from Tertiary volcanics to the east.

0.4

37.1 Benchmark - Elevation +258 MSL.

2.2

39.3 Climb up out of Yuma Wash, begin driving westerly across terrace gravels toward the Trigo Mountains. Elev. approx. +480' MSL. Trigo Mountains composed of Precambrian which extends from Colorado River, at 9:00, to approximately 1:00. Tertiary volcanics crop out north of that point. Note steep banks of wash cutting into terrace immediately south (9:00) of road at 39.9.

1.6

40.9 Enter an unnamed wash tributary to Yuma Wash. Outcrop at 9:00 complex of gneiss, schist and granite of likely Precambrian age. This complex is thought to represent the upper plate of the Chocolate Mountains - Orocopia - Vincent Thrust. Schist thought to be equivalent to the lower plate Orocopia Schist crops out 3 miles SSW of here near the mouth of Arrastra Wash.

1.1

42.0 Note geomorphology in this area with Precambrian rocks, terrace gravel remnants and recent stream alluvium.

0.4

42.4 Broken pile of whitewashed stones thought to mark the western edge of the Yuma Proving Ground. Enter BLM land.

0.3

42.7 Divide separating drainage systems of Yuma Wash and Black Rock Wash. Enter Silver District, elevation approximately +795 ft. MSL.

0.3

43.0 Bench Mark - Elev. 764', at 9:00. Note terrace gravels underlying road.

0.4

43.4 Narrow spot in road, red stained volcanics at 3:00, Precambrian at 9:00.

0.05

43.45 Outcrop of dark red conglomerate underlies terrace gravel at base of bank at 3:00. Elsewhere in the district this formation underlies a white, well bedded tuff. Also, a small vein cutting this unit has been noted in one location.

0.05

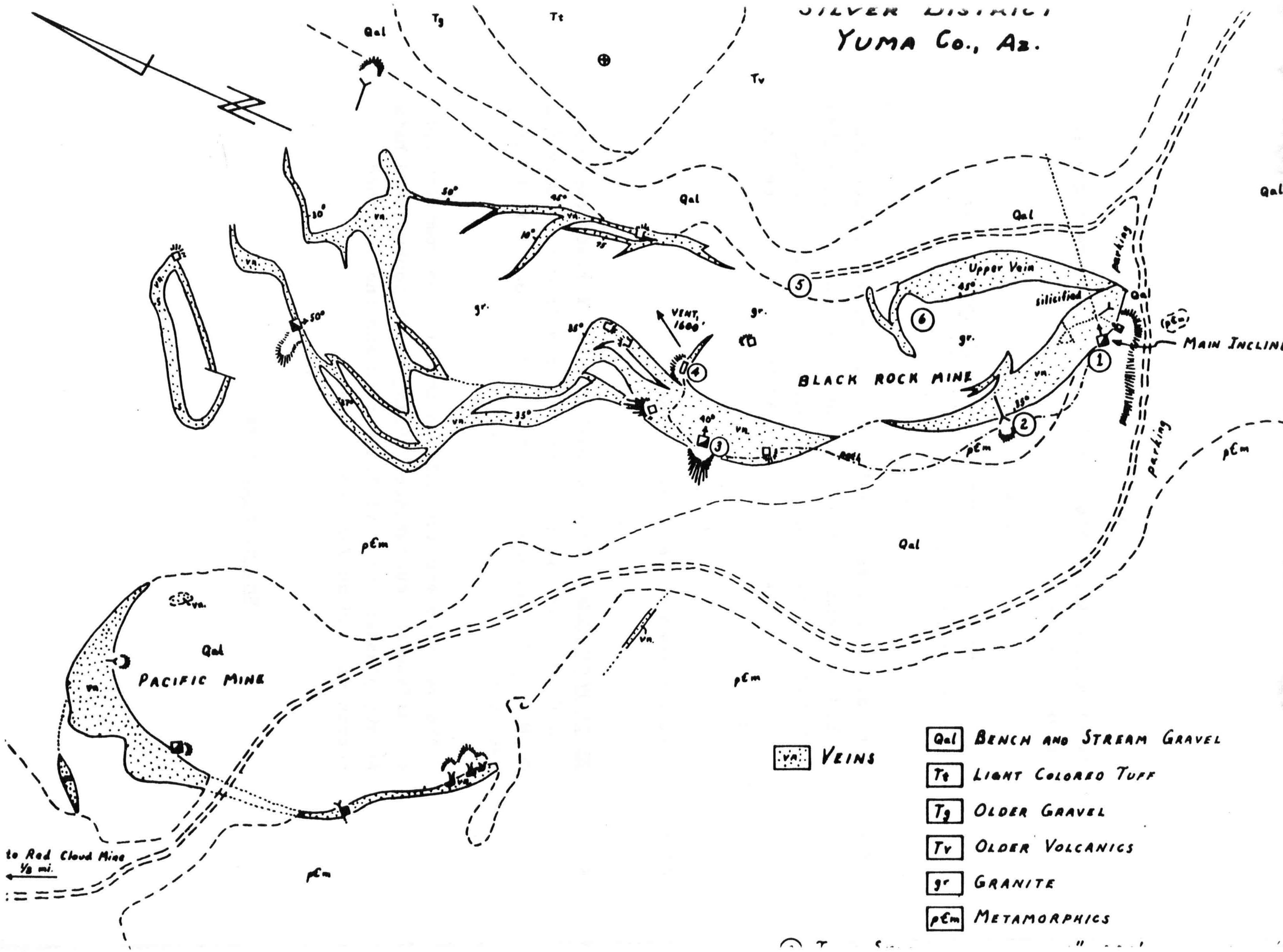
43.5 Dead End road to left, bear right.

0.2

43.7 <u>BLACK ROCK MINE</u>. Park on either side of road down wash from dump or to right of road up wash from mine workings. <u>DO NOT BLOCK THE ROAD</u>, winter visitor traffic is to be expected.

Leave vehicles and assemble on top of mine dump for tour of surface and subsurface. Bring flashlights, hard hats, safety glasses, ultraviolet lights and the attached sketch map and surface tour notes.

<u>End of road logs</u>


SILVER DISTRICT
YUMA Co., Az.
BLACK ROCK MINE
MAIN INCLINE
Upper Vein
silicified
VENT. 1600'
parking
PACIFIC MINE
to Red Cloud Mine 1/8 mi.
VEINS
Qal BENCH AND STREAM GRAVEL
Tt LIGHT COLORED TUFF
Tg OLDER GRAVEL
Tv OLDER VOLCANICS
gr GRANITE
pЄm METAMORPHICS

BLACK ROCK SURFACE TOUR

Stop 1 - Main Incline - note pseudo FW* and HW*, true FW* - outcropping mineralization.

Stop 2 - Adit - excellent exposure of FW* of lower massive vein sitting on metamorphics.

Stop 3 - North Incline - note different ages of veins, cross-cutting veins, breccia textures.

Stop 4 - Pit N. of North Incline - viewpoint,

a. N 60° W - 1000', "fishhook" shaped Pacific vein,

b. North - 150', anastomosing veins in canyon,

c. N 30° E - 1600', volcanic vent with flat, air laid tuffs.

Stop 5 - Collar of discovery drill hole, DDH #1, thickest vein intersection in District.

Stop 6 - Footwall area of Upper massive vein, strong brecciation, multiple ages of veining.

*FW - Footwall
HW - Hanging Wall

SUPPLEMENTAL ROAD LOG

Black Rock Mine to Red Cloud Mine
(Not an official part of this Tour)

Distance: 1.3 miles

(All mileages are a continuation of the mileages shown on the main road log.)

0.0

43.7 Base of Black Rock mine dump where Black Rock vein enters the wash. Continue northwest.

0.4

44.1 Optional Stop - at this point the fishhook shaped Pacific vein crosses the wash. The surface geology is shown on the Sketch map for the Black Rock tour,

0.1

44.2 Papago Mine at 9:00, 500 feet distant - developing a blind vein almost completely covered by gravel. At 11:00 the small holes in the bank of the wash were once miners dwellings, part of the town of Silent.

0.2

44.4 On skyline at 12:00, the light colored pyramid shaped peak is of flatlying volcanics overlying Precambrian. The volcanics are correlated with similar appearing material cropping out at the foot of the same ridge 500 feet lower in elevation. The intervening fault system is occupied by the Padre Kino vein.

0.4

44.8 Red Cloud mill site visible at 9:00.

0.2

45.0 Leave main road, turn about 30° left and park on flat short of mine dumps. The dumps, pit and outcrop comprise the Red Cloud mine. CAUTION - Do not approach the vertical shaft or attempt to go underground. The mining activities of rockhounds searching for wulfenite have made the workings exceedingly hazardous.

End of Road Log

Geologic Road Log

Martinez Lake Turnoff to Quartzite

Yuma County, Arizona

by R. J. Lundin

Mile Post	Miles Northward	Description
46.7	0.0	Start of Log, Martinez Lake Turnoff to the west. This road goes to Martinez Lake Landing and Marina and crosses the Yuma Proving Ground. Note the Quaternary alluvium and sediments that have been deposited on the outwash plain from the northeast extension of the Laguna Mtns.
48.4	2.7	View to the east of the Muggins Mtns. These mountains lie on the Yuma Proving Ground Military Reservation and are composed of Mesozoic metamorphics and sediments, Cretaceous volcanics, Tertiary-Cretaceous sediments and volcanics, Tertiary lacustrine and fluvial sediments, Tertiary volcanics, and Quaternary sediments. There have been a number of occurrences of Uranium noted in association with Tertiary lacustrine sediments in the area. Also, there are significant placer gold deposits in the Quaternary gravels.
50.4	2.0	View of Quaternary basalt flows forming a low hill to the northeast.
54.4	4.0	View of Chocolate Mtns. to the northwest.
54.6	0.2	Access road turnoff to the Kofa Wilderness and Castle Dome Mtns.

56.3	1.7	View of Castle Dome Mtns. and well developed desert pavement surface.
60.6	4.3	View to the southwest of lit-par-lit intrusion of pegmatitic dikes into folds in Mesozoic? metamorphics.
63.0	2.4	View of Kofa Mtns. from the southwest. The Castle Dome Mtns. and Castle Dome Mining District to the east. According to Keith (S.B. Keith, 1978), the rocks outcropping in this range consist of a thick sequence of Cretaceous-Tertiary volcanics, strongly metamorphosed sediments and a series of felsic dikes that have a general northwest trend, and the remnants of a Quaternary basalt field. Mineralization in the Castle Dome District consists of lead, silver, fluorite, barite, manganese, zinc, copper, gold, vanadium, molybdenum, beryllium, antimony, selenium, arsenic and uranium in veins and ore shoots along the dike contacts between the felsic dikes and the metamorphosed sediments and volcanics. Brecciated shear zones act as the host for most of the mineralization, but some replacement deposits have been noted in the district.
63.7	0.7	View of Quaternary volcanics to the northwest.
65.0	1.3	Contact between Quaternary volcanics and Quaternary? sediments.
65.4	0.4	View of the northern Chocolate Mtns. and Indian Wash drainage.
68.0	2.6	View of stratigraphy in Kofa Mtns. and the north end of the Castle Dome Mtns. The volcanics that make up this part of the Castle Dome Mtns. are thought to

		be Tertiary in age and may lie relatively undisturbed. The tan material at the base of the section is thought to be Tertiary or Quaternary volcanics and sediments.
72.5	4.5	View of Quaternary volcanics overlying Quaternary? sediments to the west and northwest in low hills.
74.9	2.4	Zeolites in Tertiary or Quaternary volcanics and sediments being mined by Yuma Zeolite Corp. The zeolites occur in the light tan material that outcrops to the southeast of the open-pit operations.
75.0	0.1	Quaternary volcanics in road cut.
75.7	0.7	Entering La Posa Plain-Tyson Wash area.
77.1	1.4	Stone Cabin Store & Kofa Mtns.-King Valley Turnoff.
80.3	3.2	View of the volcanic stratigraphy in the northern Castle Dome Mtns. and the Kofa Mtns. to the west and northeast.
82.0	1.7	Cibola Lake Turnoff.
84.5	2.5	View of the Kofa and Plomosa Mtns. to the northeast and east and the Trigo Peaks to the west and northwest. According the Keith, the Kofa's are composed of Mesozoic schist and slates. Mineralization in the Kofa or S.H. Mining District consists of gold, silver, manganese, tungsten, copper, and lead in lensing fissure veins that cut both the volcanics and the metamorphics.
84.9	0.4	Palm Canyon Turnoff.
95.0	10.1	View to the west of the upended

		stratigraphy in the southern Dome Rock Mtns. and to the east of the central portion of the Plomosa Mtns. The Dome Rock Mtns. consist of strongly deformed and metamorphosed sediments that have been repeatedly faulted and intruded by Mesozoic? granite intrusives. In the area of La Cholla Peak there are numerous gold placer deposits and throughout the range there are fissure type gold, silver, copper, lead, zinc, molybdenum and mercury deposits. The Plomosa Mtns. are comparatively, less disturbed and are composed of metamorphosed Paleozoic and Mesozoic sediments, Tertiary volcanics andsediments, and Laramide intrusives. Mineralization occurs as gold, silver, copper, lead, zinc, manganese, barite, iron, tungsten and beryllium deposits in veins and replacement deposits in the entire range of host rocks.
96.5	1.5	Crystal Hill, Kofa Game Range Turnoff.
102.7	6.2	La Posa BLM Campground.
104.6	1.9	View of BLM Campground to the west and of mining operations on the eastern flank of Granite Mtn. in the Middle Camp-Oro Fino Mining District. Mineralization consists of gold, silver, copper. lead, and zinc values in quartz veins along the contact between Mesozoic granite bodies and later pegmatite dikes.
106.0	1.4	Quartzite, Arizona (End of Log)

Reference: Keith, S. B., Index of Mining Properties of Yuma County, Arizona: Ariz. Bur. Geology & Min. Tech. Bull. 192 (1978)

GENERAL GEOLOGY ALONG INTERSTATE 10 FROM QUARTZITE TO BUCKEYE -- AN INFORMAL ROAD LOG

by
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The following is an informal geologic road log of Interstate 10 between Quartzite and Buckeye (Figure 1). I consider it informal as I have not included mileposts, simply because there are few roadcuts along the way and none that are worthwhile. Also, it would be difficult, if not impossible, for anyone to lose their way. Instead, I have chosen a less conventional format for describing the geology. Major exits will be identified where travelers can pull off and read summarized geology of mountain ranges along the next stretch of road. In addition, possible interesting side trips that start at these exits will be suggested. Readers are encouraged to bring a copy of the 1969 State Geologic Map (preferably cut up into sheets of manageable sizes). In addition, a copy of Arizona Bureau of Geology and Mineral Technology Bulletin 192 entitled "Index of Mining Properties in Yuma County, Arizona" by Stanton B. Keith (1978) is heartily recommended. This bulletin provides excellent summaries of past geologic studies, histories of mineral exploration and production, early lore, and origin of place names. Much of this valuable data is disseminated throughout this road log.

Start -- Quartzite

Quartzite lies within the La Posa Plain (Figure 2), a north-south trending valley whose bottom is approximately 900' above sea level in the area of the city. The valley's major drainage, Tyson Wash, flows north-northwest from Quartzite, eventually joining the Colorado River Valley. Mountain fronts adjacent to the plain are sinuous and deeply embayed.

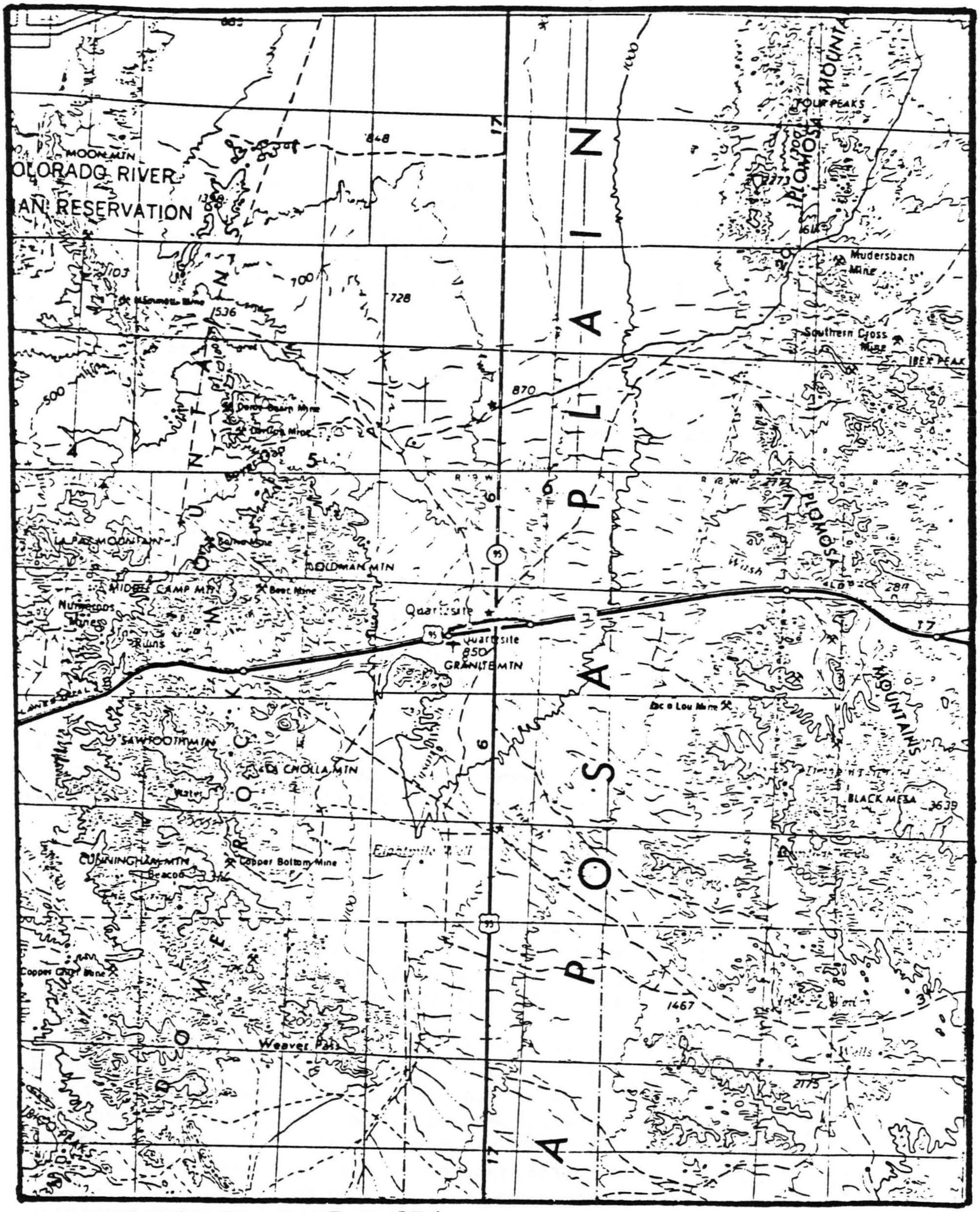
West of Quartzite are the Dome Rock Mountains. Exposed immediately north of and within the low pass I-10 follows to the west is a granitic pluton of probable Jurassic age. It is locally altered and intruded by a younger, equigranular Late Cretaceous(?) quartz monzonite. The Jurassic(?) granite intrudes a sequence of slightly metamorphosed volcanic and volcaniclastic rocks which crop out extensively south of I-10 (mapped on State Geologic Map as Mesozoic schist). Further south, the volcanics are overlain by a thick sequence of interbedded quartzites, quartz pebble conglomerates, and phyllites (mapped as Mesozoic sediments). Two Univ. of Arizona master's theses are in progress concerning this mountain range (William Crowl and Stephen Marshak). Mining activity in the area was predominantly concerned with significant gold placers, minor gold veins, and sporadic copper-lead-zinc mineralization adjacent to the granitic plutons. Total metal production for the area through 1974 is slightly greater than $2.6 million (Keith, 1978).

South-southeast of Quartzite are the physiographically distinctive Kofa Mountains. The range has a basement of Mesozoic sedimentary and plutonic rocks overlain by a thick sequence of mid-Tertiary volcanics. Intermediate to felsic ash-flow tuffs and associated flows and volcaniclastic strata dominate the volcanic section. The area may be a major volcanic center.

East of Quartzite are the Plomosa Mountains. Jemmet (1966) has mapped the northern Plomosa Mountains, Miller (1966, 1970) has mapped the southern part of the range, and Harding (1978) and Robinson (in progress) have studied Mesozoic stratigraphy of the southern half of the range.

In the northern Plomosas northeast of Quartzite, probable Precambrian basement and metamorphosed Paleozoic and Mesozoic(?) strata are exposed along with mid-Tertiary volcanic and clastic rocks. The central Plomosa Mountains (immediately north of I-10) are almost entirely composed of mid-Tertiary volcanics. Complex geology dominates the southern Plomosa Mountains with exposures of Precambrian quartz monzonite; metamorphosed and unmetamorphosed Paleozoic strata (including Bolsa Quartzite, Abrigo Formation, Martin Formation, Escabrosa Limestone, and Supai Formation, Coconino Sandstone, and Kaibab Limestone); Mesozoic metavolcanics, Continental Redbeds, and Livingston Hills Formation (thick sequence of conglomerate, sandstone and siltstone); abundant Mesozoic(?) intrusive-extrusive silicic igneous rocks; and mid-Tertiary andesite and basalt. Pre-Tertiary formations are locally metamorphosed and displaced by low-angle faults. Most rock units, including the mid-Tertiary volcanics are

FIGURE 2



AMS SHEET: SALTON SEA

Scale 1:250,000

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5 0 5 10 15 20 25 30 Kilometers

5 0 5 10 15 Nautical Miles

CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100 FOOT INTERVALS

TRANSVERSE MERCATOR PROJECTION

in places cut by northwest-trending dip-slip and strike-slip faults.

Mineralization in the Plomosa Mountains is as varied as the geology (Keith, 1978). Deposits of copper-gold, lead-zinc-silver, barite-fluorite, tungsten, and gold placers have all been worked.

STOP 1 -- Gold Nugget Road (7 miles east of Quartzsite)

Mid-Tertiary andesites are exposed north of exit and in small, flat-topped hills immediately south of exit. After exiting, drive south on paved road for approximately 1/2 mile. From here, Paleozoic rocks, clearly visible to southwest, can be reached via 1/2 mile hike. Higher hills behind Paleozoics are composed of Precambrian quartz monzonite. Miocene(?) basalts are exposed to the southeast. The dirt road that turns south from paved road follows up Italian and Apache Washes. This road provides access to excellent exposures of the Precambrian quartz monzonite, Mesozoic Continental Redbeds and Livingston Hills Formation, and low-angle fault contacts between different units. Miller's (1970) GQ is a must for those interested in examining the fascinating geology of this range.

VIEWPOINT 2 (no stop needed) -- Junction U.S. 60 (4 miles east of last exit)

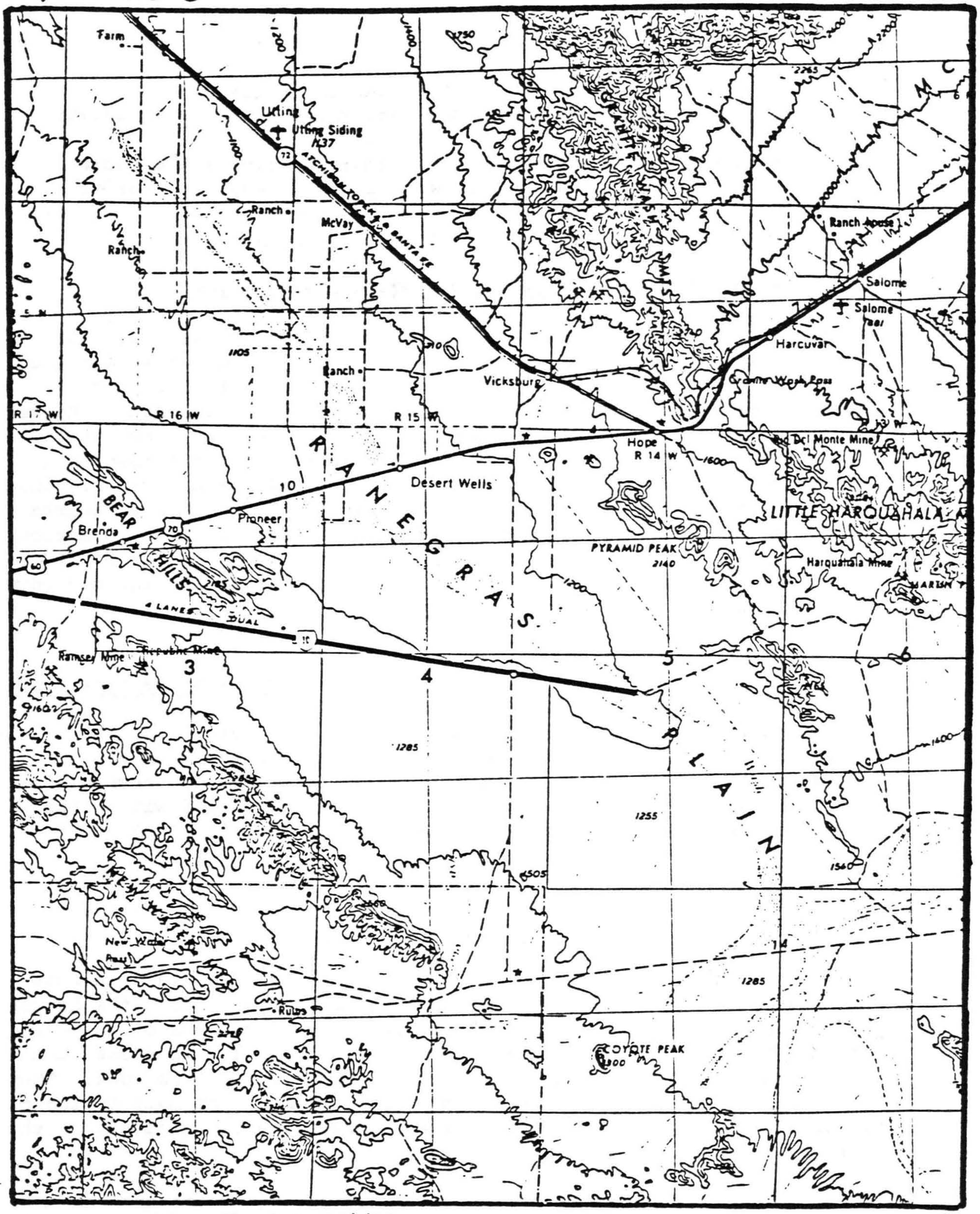
U.S. 60 bears ENE through Salome, Wenden and ultimately Wickenburg. Five miles east of this junction, U.S. 60 passes through the Bear Hills (Figure 3), clearly visible in the foreground. In these hills, Mid-Tertiary andesitic volcanics contain fractures filled with copper-silver-gold mineralization and manganese oxides (Keith, 1978). Interstate entering Ranegras Plain.

STOP 3 -- Vicksburg Road (14 miles east Junction US 60)

Northeast of here (Figure 3), U.S. 60 enters Granite Wash Pass which separates the Granite Wash Mountains to the north from the Little Harquahala Mountains to the south. Along the western side of the Granite Wash Mountains are gently dipping Mesozoic sandstones, siltstone, shale, and conglomerate and interlayered sills(?) of mafic igneous rock. They are locally highly metamorphosed and cut by two distinct Late Cretaceous plutons. Copper-gold and tungsten mineralization occur adjacent to the plutons.

South of Granite Wash Pass are the Little Harquahala Mountains, an area whose geology is varied and complex. The Granite Wash Pass granodiorite extends into the north part of the range where it intrudes Mesozoic strata. Mesozoic rocks, widely exposed in the western parts of the range, consist of volcanic and volcaniclastic sequences, quartz-rich and feldspathic sandstones, and local carbonates. These are in faulted contact with an altered, porphyritic granite (Precambrian?) to the east.

FIGURE 3



AMS SHEET: PHOENIX

Scale 1:250,000

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5 0 5 10 15 20 25 30 Kilometers

5 0 5 10 15 Nautical Miles

CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100 FOOT INTERVALS

TRANSVERSE MERCATOR PROJECTION

The southeast portions of the range (with obvious layering) are Paleozoic strata including Bolsa, Abrigo, Martin, Redwall and Supai equivalents. These rocks strike northeast, are folded and locally overturned, and overlie the porphyritic granite along a low-angle fault. Pyramid Peak and associated bedrock outliers west of the range are composed of mid-Tertiary volcanics. Upper Bouse Wash flows (intermittantly) northerly between Pyramid Peak and Vicksburg exit.

The most important mineral deposits in the Little Harquahala Mountains are the Bonanza and Gold Eagle mines which contained shoots of high grade gold ore.

Mining was active in the late 19th century and total precious and base metal production in the district is valued at nearly $3 million (Keith, 1978).

South of I-10 are the New Water, Little Horn, and more distant Kofa Mountains. All three ranges are composed predominately of mid-Tertiary volcanics and all exhibit interesting physiographies. Copper and gold-silver mineralization occurs in these ranges.

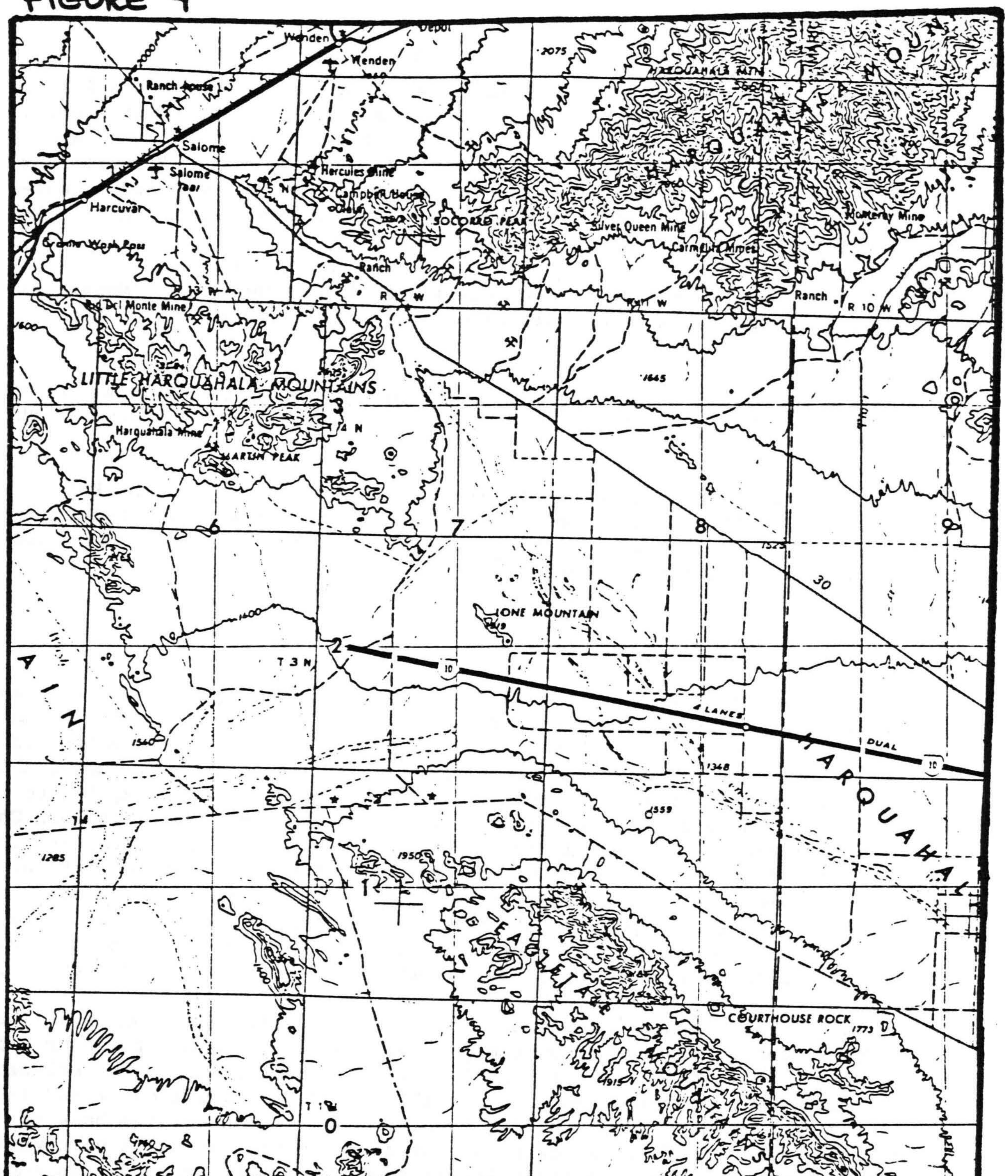
STOP 4 -- Hovatter Road (8 miles east Vicksburg exit)

Here we are near the boundary between the Ranegras Plain to the west and Harquahala Plain to the east. The small hills immediately north of the exit are mid-Tertiary volcanics (andesites). In the subdued Black Rock Hills south of the exit, three distinct rock units crop out. Along the western edge quartzite, siltstone, and quartz-pebble conglomerate are exposed. These rocks are probably correlatives of Miller's Mesozoic Continental Redbeds in the Quartzite Quadrangle. To the east, they are in apparent fault contact with minor exposures of Mesozoic volcanic flows and agglomerates. The volcanics overlie a west-dipping fault whose footwall contains a porphyritic granite, similar to that in the Little Harquahala Mountains. These relationships can be seen from short hikes south off the well-maintained dirt road that extends south from the exit.

Similar relationships described for the Little Harquahala Mountains (see STOP 3) can be examined from the generally well-maintained road north of the exit (road to Salome via Little Harquahala Mountains). The Paleozoic section (Bolsa, Abrigo, Martin, Redwall, and Supai equivalents) and its fault contact with an underlying granite can be seen near the base of Martin Peak, the first large peak east of the road. In hills northwest of Martin Peak, the Mesozoic volcanic section is well exposed. In addition, the gold mines of the area (Bonanza Mine and Golden Eagle Mine) are easily accessible north of Martin Peak.

Northeast of the Little Harquahala Mountains is the larger, broad crest of the Harquahala Mountains (Figure 4). Varga (1977) has studied the geology of the western end of the range. In this part of the range a

FIGURE 4



AMS SHEET: PHOENIX

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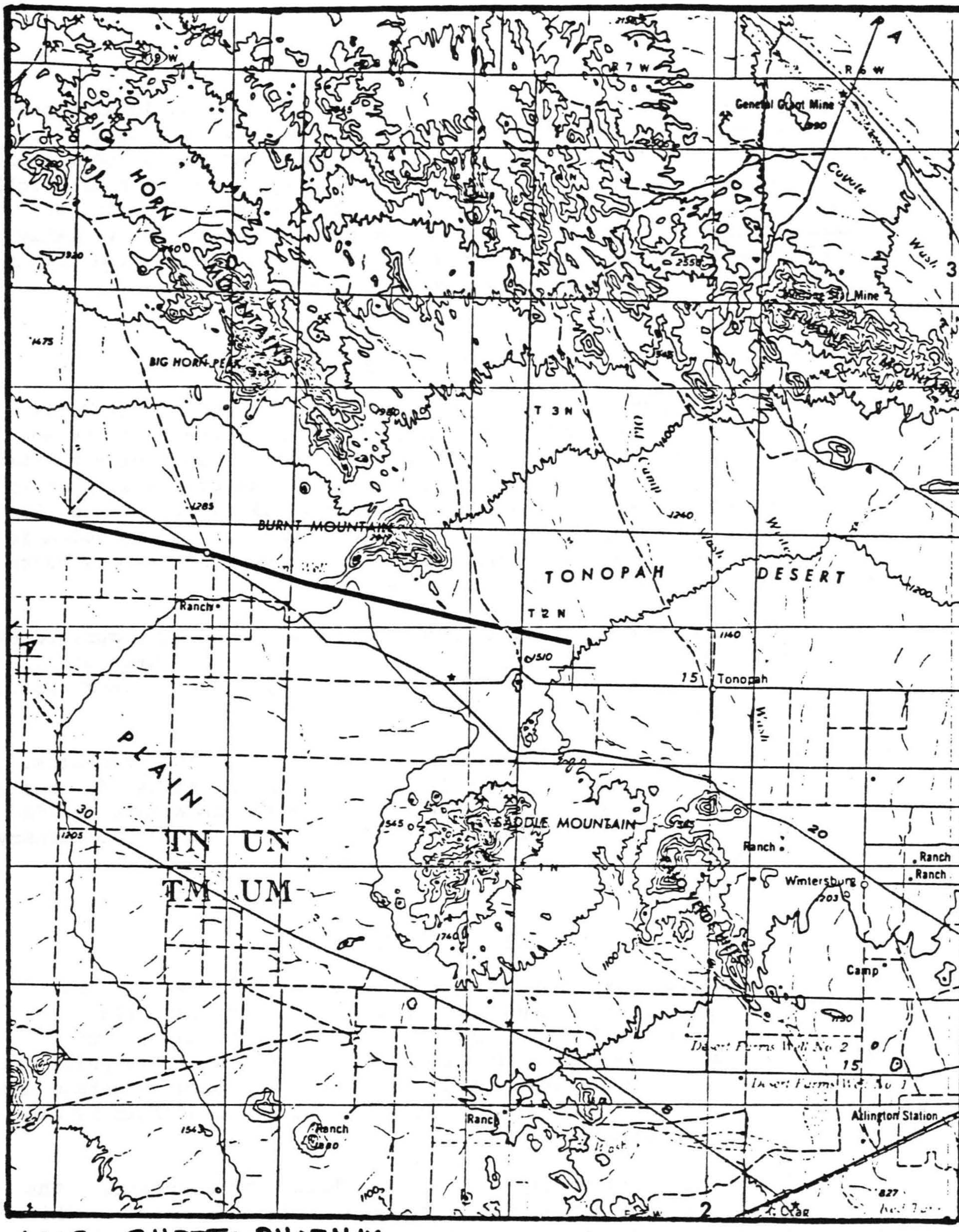
CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100 FOOT INTERVALS

TRANSVERSE MERCATOR PROJECTION

FIGURE 5



AMS SHEET: PHOENIX

Scale 1:250,000

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5 0 5 10 15 20 25 30 Kilometers

5 0 5 10 15 Nautical Miles

CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100 FOOT INTERVALS

TRANSVERSE MERCATOR PROJECTION

folded and faulted Paleozoic section overlies an altered, locally porpyritic granite. The higher main part of the range is composed of a complex assortment of plutonic (locally foliated) and metamorphic rocks. Paleozoic rocks exposed on the southeastern edge of the range are highly metamorphosed and deformed but include probable Permian Coconino and Kaibab formations. The southern flank of the range contains variably metamorphosed Mesozoic(?) impure clastic rocks. Mineralization within the range includes showings of copper, gold, and tungsten.

STOP 5 -- Salome Road (28 miles east of Hovatter Road)

From this exit (Figure 4), excellent views are afforded of the Eagle Tail Mountains southwest of I-10. These mountains reveal a thick sequence of mid-Tertiary ash-flow tuff and lava, which dip gently to the southwest. They overlie a basement of locally foliated granitic rocks and are intruded by numerous northwest-trending dikes, sills, and plugs. Copper, gold, and silver occurs in fractures cutting both the volcanic and basement rocks (Keith, 1978). The single large, flat-topped butte in the center of the range is Courthouse Rock.

North of I-10 are the Big Horn Mountains which are largely comprised of mid-Tertiary volcanic rocks. The volcanics rest on a basement of Precambrian metamorphics and later granodiorite. Copper-gold mineralization occurs sporadically through the range.

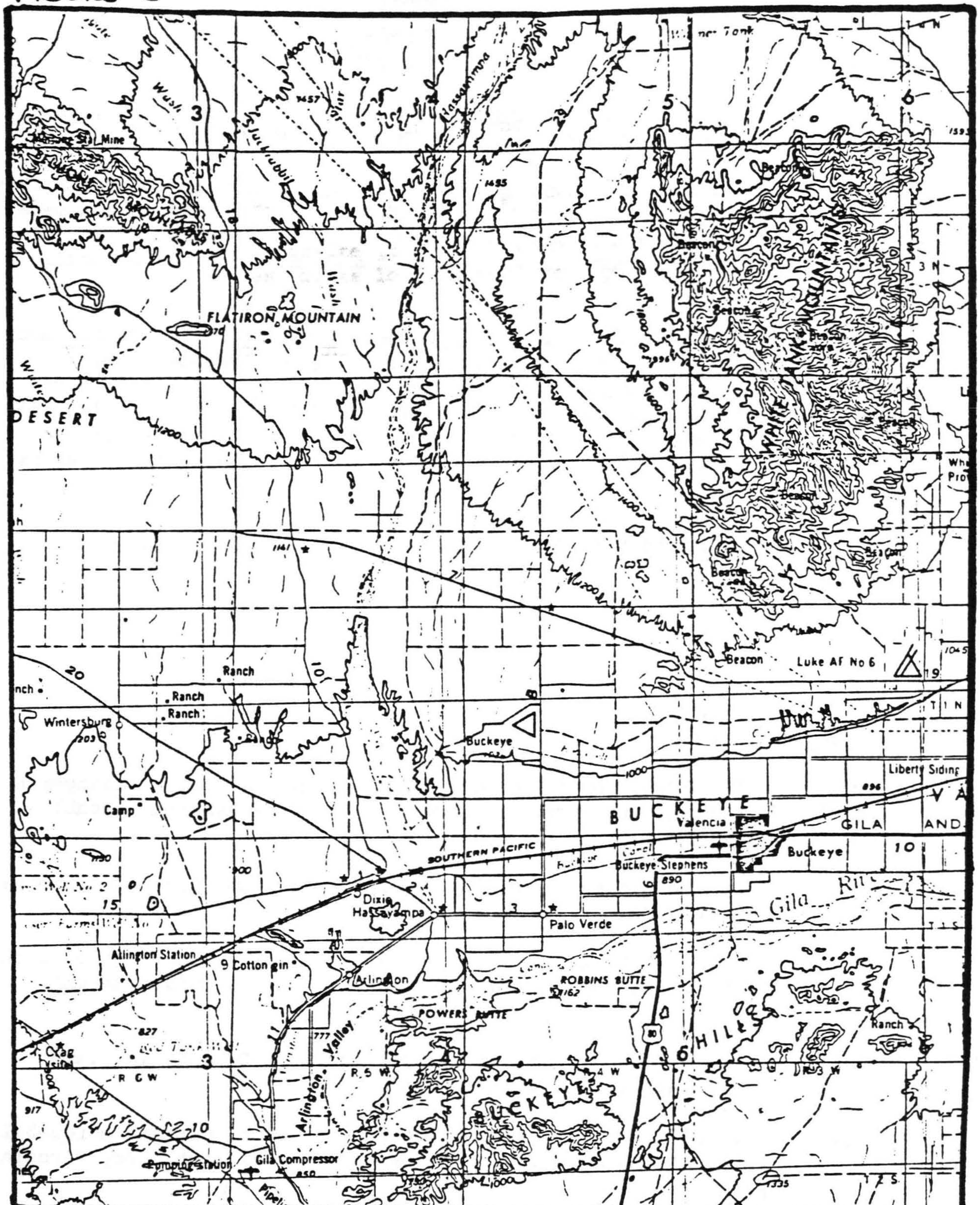
Due south of this exit (in the distance) are the Gila Bend Mountains. In this range, Miocene volcanics overlie a Precambrian basement of granite and metamorphics. Several young basalt flows in the area have yielded Late Miocene to early Pleistocene K-Ar ages (as reported in Preliminary report for Palo Verde Nuclear Generator site).

STOP 6 -- Tonopah (13 miles east of Salome Road)

This stop is within the Tonopah Desert (Figures 5 and 6). The Hassayampa River lies to the east and flows south into the Gila River southwest of Buckeye. North of the Tonopah desert are the Belmont Mountains, a range composed of Precambrian granite and metamorphics, mid-Tertiary volcanics, and abundant Tertiary dikes. Flatiron Mountain and additional buttes south of the Belmont Mountains are underlain by mid-Tertiary andesitic volcanics.

The high range directly to the east is the White Tank Mountains. The mountains are one of a series of "metamorphic core complexes" in this region (others include Harquahala and South Mountains). Precambrian gneiss and younger granitic intrusives make up most of the range. Both rock types locally exhibit a gently dipping mylonitic foliation on the east flank of the range. Muscovite granite and alaskite-pegmatite are abundant near the crest of the range. Porphyritic Precambrian granite

FIGURE 6



AMS SHEET: PHOENIX

Scale 1:250,000

5 0 5 10 15 20 Statute Miles

5 0 5 10 15 20 25 30 Kilometers

5 0 5 10 15 Nautical Miles

CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100 FOOT INTERVALS

TRANSVERSE MERCATOR PROJECTION

is exposed at the range's southern end while a probable Tertiary pluton is exposed in the northwestern corner of the range.

South of the White Tank Mountains are the topographically subdued Buckeye Hills. Rock exposed in the hills include Precambrian granite and metamorphics plus a muscovite granite, alaskite, and pegmatite complex of unknown age. These rocks locally exhibit a gently inclined mylonitic foliation.

Immediately south of this stop are the Palo Verde Hills and Saddle Mountain (to the west). Both are composed of a thick sequence of mid-Tertiary volcanics ranging from andesite to rhyolite. The Palo Verde Nuclear Generating facility is being constructed east of the Palo Verde Hills. In the small hill north of Saddle Mountain, a greenschist is exposed whose coloration can generally be seen from moderate distances.

EXIT 7 -- Turnoff to U.S. 80 (19 miles east of Tonopah Exit)

End of Road Log.

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