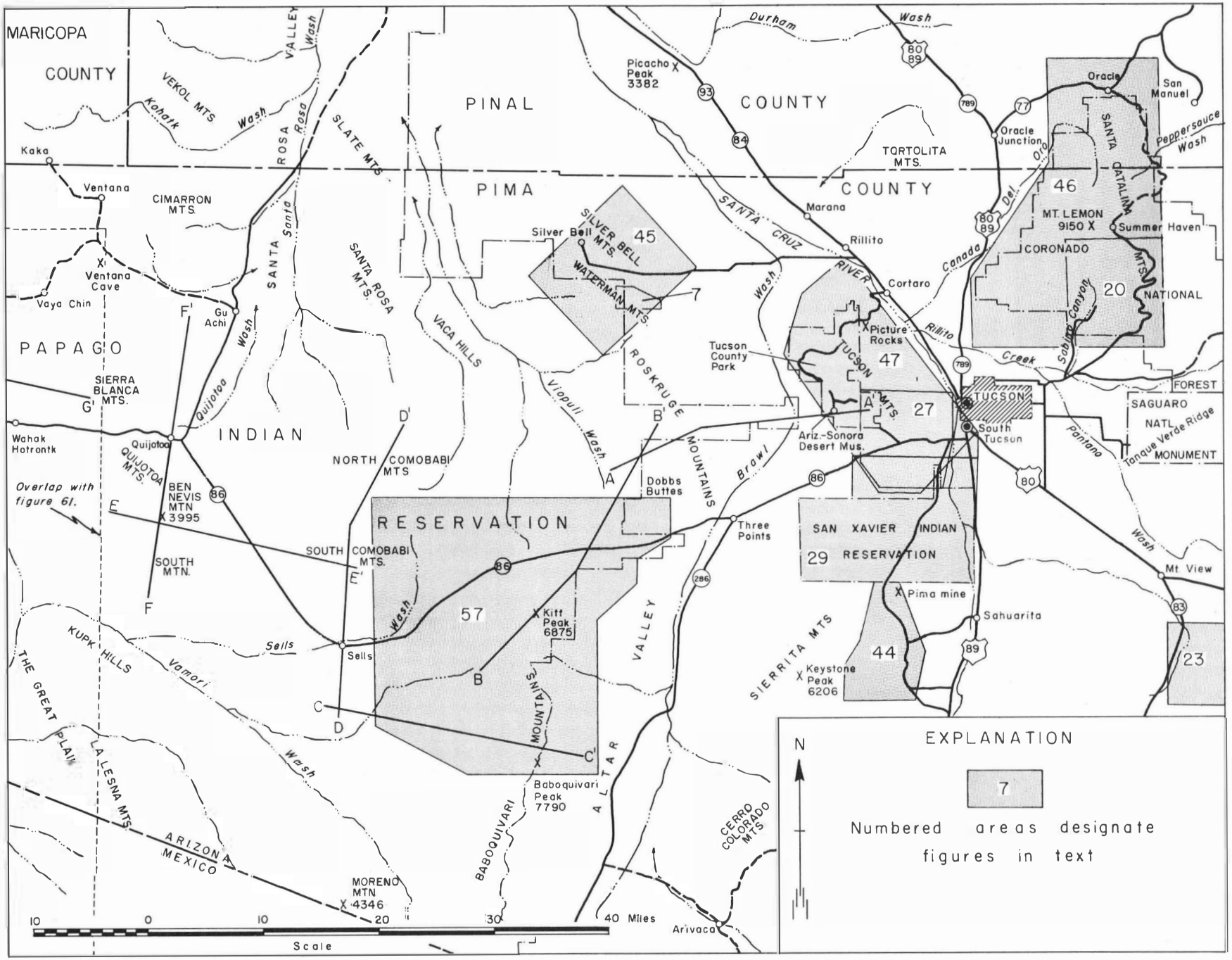


FIGURE 55. Index map of a part of central southern Arizona showing route of east half of Field Trip VI, locations and figure numbers of maps for Field Trips I, II, III, and IV and related articles, and generalized locations of diagrammatic cross sections shown in figures 56, 59, and 60.

VOLCANIC CRATERS OF THE PINACATE MOUNTAINS, SONORA, MEXICO

TRIP VI, ROAD LOG

First Day, Sunday, April 5, 1959

Leaders: F. W. Galbraith, L. A. Heindl, and G. G. Sykes

Driving Distance: 200.7 miles Logged Distance: 200.7 miles

Note: This trip will leave at 6:00 A. M. from the parking lot north of the Geology building.

General Statement:

The principal purpose of this trip is to examine the volcanic features of the Pinacate Mountains in Sonora, Mexico (fig. 1). The trip (figs. 55 and 61) passes through a part of the Tucson Mountains discussed in Field Trip IV and north of the Sierrita Mountains (Field Trip I). West of the areas discussed in other road logs, most of the rocks along the route are of probable post-Paleozoic age and are composed of Mesozoic volcanic and sedimentary rocks, Mesozoic and early Tertiary (?) intrusive and metamorphic rocks, and Tertiary intrusive, sedimentary, and volcanic rocks. A small, but unseparated, part of the gneissic and granitoid rocks may be of Precambrian age and there are a few exposures of Paleozoic limestone in faulted slivers. The basin-and-range physiography reflects Tertiary faulting, folding, and extrusion along northerly and northwesterly trends. Within the mountain ranges themselves, these late Tertiary trends are less obvious, and the older rocks have been intricately dislocated, folded, and intruded along other alignments.

Much of the early part of the trip is through the Papago Indian Reservation and the Organ Pipe Cactus National Monument. At Lukeville, Arizona, the route crosses into the State of Sonora, Mexico, and continues through some of the desert area drained by the Rio Sonoyta. The approximately 180 miles to the Pinacate Mountains must be covered before lunch, which will be served at the campsite, Stop 4, at the foot of Crater Elegante on the northeast slopes of the Pinacate Mountains. Stop 1 is for gas and coffee, but from it may be seen some of the Tertiary volcanic rocks and structures. Stop 2, at Lukeville, is for immigration control purposes. At Stop 3, a watering point, the party will have a splendid panorama of the country along the United States-Mexico boundary west of the Mexican town of Sonoyta and an opportunity to examine a contact area between igneous and metamorphosed rocks.

The afternoon will be spent examining Elegante Crater.

0.0	0.0	Intersection of Speedway Boulevard and U. S. Highway 80. Watch signal lights; TURN LEFT.
1.0	1.0	Congress Street signal lights; CONTINUE STRAIGHT AHEAD.
1.4	2.4	Intersection with 29th Street. TURN RIGHT.
0.5	2.9	Bridge across Santa Cruz River.
0.5	3.4	Road swings left and joins Mission Road. Continue southward.
1.6	5.0	Intersection of Mission Road and State Highway 86 (Ajo Road). STOP. TURN RIGHT. Geology for next 4 miles is covered in Field Trip IV, mileages 5.0 to 9.2.
4.1	9.1	Road to right goes to the Arizona Sonora Desert Museum. Ahead is Avra Valley.
2.7	11.8	At 9:00, Snyder Hill, composed of Permian limestone, is the type locality for the now superceded Snyder Hill formation (Stoyanow, 1936). This hill has been interpreted as a klippe on Cretaceous rocks (Brown, 1939) and as part of the west limb of a large synclinorium (Kinnison, 24).
0.7	12.5	Milepost 163. At 9:00 is the flagged site of a nearly 500-foot dry test hole, all in alluvium. This hole suggests that the east-west discontinuity in groundwater levels, and a probable structural break between shallow and deep bedrock, lie

EXPLANATION

QTal — Valley fill; undeformed where exposed; may cover deformed alluvial deposits at depth.

Tba — Basaltic and andesitic flows and dikes; some interbedded conglomerate.

Tal — Alluvium, deformed by normal faulting; may be of different ages in different areas.

Ta — Andesitic flows and intrusive rocks.

Tst — Silicic tuff, agglomerate, and flows.

Tap — Andesite porphyry flows.

Tas — Silicic tuff, agglomerate, and flows, with some andesitic rocks.

Ti — Shallow intrusive rocks, principally silicic; may include some older shallow intrusive rocks

Taf — Angular to well-rounded fanglomerate; deformed by normal and thrust faulting; locally metamorphosed; may be of different ages in different areas.

Tr / Tqi — Rhyolitic, latitic, and quartz-latitic tuff, agglomerate, flows, and intrusive bodies; may be of different ages in different areas

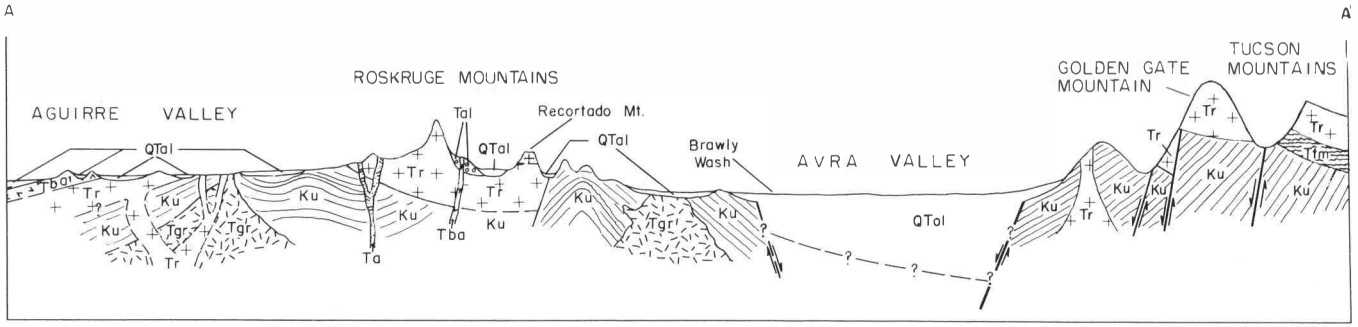
Ttm — Tucson Mountain chaos—giant breccia and conglomerate.

Tgr / T?gr / K?gr — Intrusive rocks; diorite, quartz monzonite, alaskite, granite; Tgr cuts younger Mesozoic-early Tertiary rocks, T?gr cuts older Mesozoic-early Tertiary rocks, and K?gr cuts Paleozoic rocks; may represent several periods of intrusion.

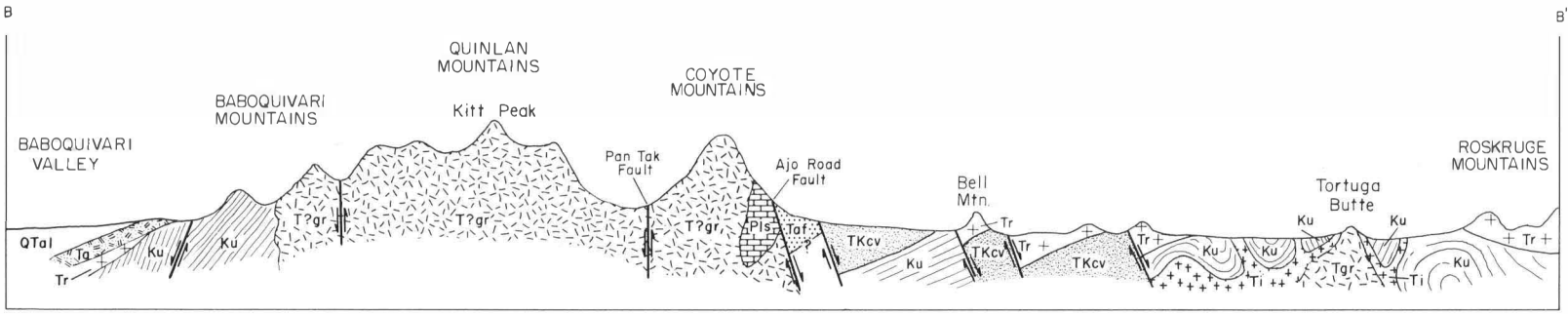
TKcv — Volcanic conglomerate and breccia, composed principally of andesitic porphyry fragments.

Ku / K?v — Conglomerate, arkose, mudstone, and volcanic rocks; of at least two ages; K?v, locally separated volcanic rocks.

Pls — Paleozoic limestone.



Cross-section A-A' trends generally N. 70° E. and is viewed looking north between Field Trip VI mileages 12.9 and 35.9; approximate length of cross section, 24 miles.



Cross-section B-B' trends generally N. 30° E. and is viewed looking west between Field Trip VI mileages 30.1 and 39.8 and looking southeast between mileages 46.5 and 54.3; approximate length of cross section, 30 miles.

FIGURE 56. Diagrammatic cross sections A-A' and B-B' located on figure 55 and explanation to accompany cross sections referred to in Field Trip VI. Cross sections are not to scale; vertical exaggeration is approximately x5.

between Snyder Hill and this point (Heindl, 25). From here the Pima mining district and the Sierrita Mountains are from 9:30 to 10:00 and the Baboquivari, Coyote, and Roskruge Mountains are from 11:30 to 1:30 (fig. 55).

0.4	12.9	The general line of cross-section A-A' (fig. 56) can be seen from Ricortado Mountain, the black, flat-topped mesa at 2:00, to Golden Gate Mountain and the western escarpment of the Tucson Mountains at 4:00. The low olive-green hills on either side of Ricortado Mountain are composed of Cretaceous (?) sedimentary rocks which to the east are covered by the alluvium of Avra Valley. Similar Cretaceous rocks crop out on the west side of the Tucson Mountains.
1.1	14.0	Curve. At 12:00, Baboquivari Peak, a granite spire, rises to 7,730 feet above sea level at the intersection of a series of northwest and east-west trending shears and fractures, some of which are filled with late dikes (fig. 57). Granite ordinarily weathers readily in this region and the reasons for Baboquivari's unusual resistance are more argued than known. The peak is sacred to the Papago Indians as the home of Etoi-Kam, their creator and elder brother.
1.7	15.7	At 3:00, Ryan Air Field. A training field during World War II, it is now used principally by the Civil Air Patrol, National Guard, a local parachute club, and amateur rocketeers.
2.1	17.8	At 3:00, tailings and dumps of the Silver Bell mine between the Waterman and Silver Bell Mountains (Field Trip II). The dark hill in the distant foreground is Cocoraque Butte, famous locally for the petroglyphs that cover its west face.
1.0	18.8	Road to right is the main north-south road through the irrigated areas in Avra Valley.
6.1	24.9	Three Points. Continue straight ahead. Road left goes to Sasabe, a small community on the United States-Mexico border, and is the principal access to Altar Valley, between the Sierrita and Baboquivari Mountains.
1.5	26.4	Middle of 3 bridges across Brawly Wash. Note degree of entrenchment.
2.8	29.2	Highway passes between low rounded hills which form the southern end of the Roskruge Mountains. They are composed of moderately tilted and warped andesitic and basaltic flows of probable late Tertiary age. To the north, these flows overlie unconformably a sequence of rhyolitic tuff, agglomerate, welded tuff, and flow rocks of probable middle Tertiary age. The rhyolitic rocks may be in part the equivalent of the Cat Mountain rhyolite (Brown, 1939) in the Tucson Mountains.
0.9	30.1	At 12:00, Coyote Mountains; at 1:00, Martina Mountain, one of the Dobbs Buttes, which extend to about 2:00. The Dobbs Buttes form a part of the Roskruge Mountains and consist of separate blocks of tilted colorful silicic volcanic rocks (fig. 57). The Roskruge Mountains, at 3:00, are composed of similar silicic rocks which have been gently folded into a broad east-plunging anticline. On the east side, the silicic rocks are faulted against steeply dipping Cretaceous (?) volcanic and sedimentary rocks. Cross-section B-B' (fig. 56) shows generalized structural relationships southwest from the Dobbs Buttes, through the Coyote and Quinlan Mountains, to the valley on the west side of the Baboquivari Mountains.
0.2	30.3	Papago Indian Reservation boundary. This reservation contains nearly 4,200 square miles and the trip will be within its boundaries for the next 90 miles. According to the Papago Indians, they have lived within the Sonoran desert, on both sides of the International Boundary, since their creation. Prior to the coming of the Spaniards, they lived off the land, hunting, gathering, farming, and, when necessary, working for their farming cousins to the north, the Pimas. The Spaniards brought cattle and additional crops, and the Papago Indians now depend principally on cattle raising in addition to farming and off-reservation work. The Papago Tribal Council has invited members of the party to stop at Sells, the reservation capitol, and has permitted the party to examine geological features at leisure following the field trip. Enter area shown in figure 57.
2.7	33.0	At 3:00, road cut at the foot of Martina Mountain shows light red-brown tuff,

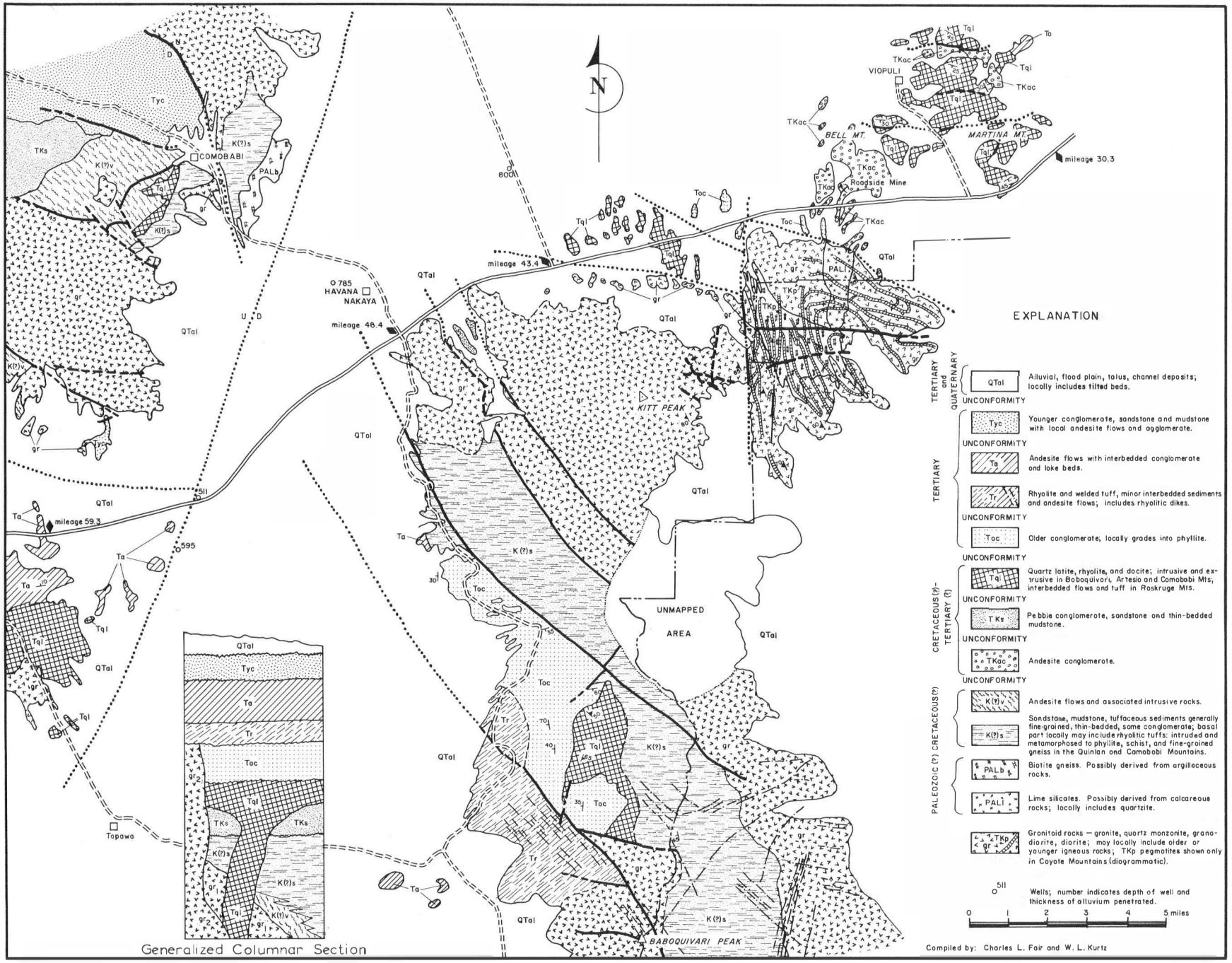


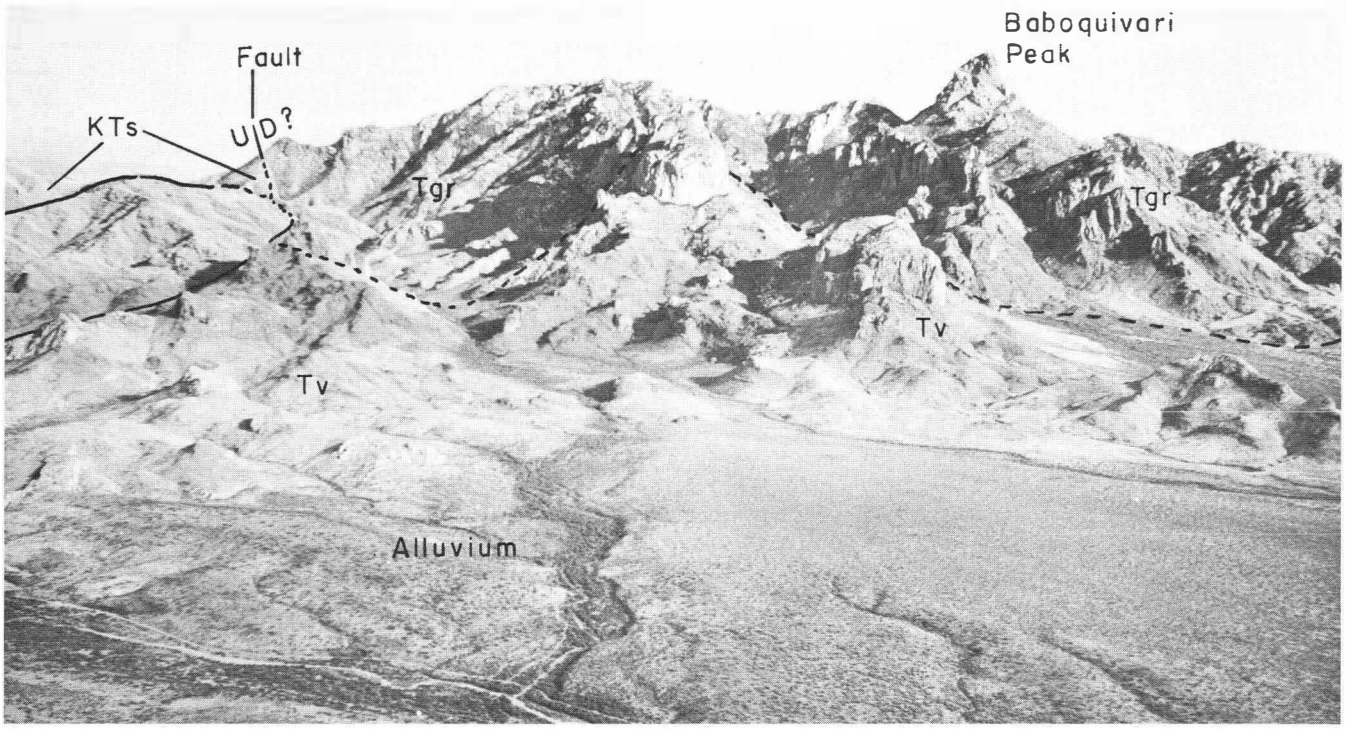
FIGURE 57. Generalized geologic map of parts of the Baboquivari, Roskruge, South Comobabi, and Artesa Mountains, Pima County, Arizona.

		one of the colorful volcanic units forming the Dobbs Buttes and the Roskruge Mountains. The gray-green boulders and cobbles in the float are dacite from flows capping Martina Mountain.
0.3	33.3	At 1:00, Bell Mountain. Watch bell shape develop in next 2 miles.
0.6	33.9	Road on right goes to the Papago village of Viopuli (wild tobacco). Many of the Papago names shown on official maps are no longer used, even by the Indians themselves. Anglo-American attempts to pronounce the Papago names are a sure source of amusement to the Papago, and, in the case of Viopuli, will provoke the question, "You mean San Pedro?"
1.1	35.0	At 3:00, a good view of the Dobbs Buttes, a series of small tilted fault blocks. At about 11:00, directly below Coyote Peak, the Ajo Road fault (figs. 56 B-B', 57) is exposed below the upper slopes of a prominent alluvial fan. The Ajo Road fault marks the contact between the gneissic rocks to the south and the Cretaceous (?) and Tertiary rocks to the north.
0.9	35.9	Old highway bears toward right and past the Roadside Mine, whose main shaft is sunk about 800 feet into Cretaceous (?) volcanic and sedimentary rocks (figs. 56 B-B', 57).
0.7	36.6	First of a series of road cuts in Cretaceous (?) andesitic agglomerate and conglomerate beds. Note thick development of caliche. This area is covered by a thick stand of yucca and palo verde.
1.3	37.9	Deep wash incised in reddish-purple conglomerate of probable older Tertiary age.
0.7	38.6	At 9:00, well-developed eroded fan apices in narrow ravine. The moderate east dip of the foliation in the gneisses composing the Coyote Mountains is readily seen above the fan. These gneisses may be younger than Precambrian (Wargo and Kurtz, 1956).
0.4	39.0	At 11:00, first view of Kitt Peak in the Quinlan Mountains. The tower on Kitt Peak was designed to record automatically year-round visibility conditions for the new National Astronomical Observatory to be constructed on Kitt Peak by the National Science Foundation. Eventual facilities will include new 84-inch and 36-inch telescopes and the University of Arizona 36-inch telescope now located on the University campus (Meinel, 1958).
0.8	39.8	Road left to Pan Tak (Coyote) Village. At 9:00, gap between the Coyote and Quinlan Mountains is formed along a high-angle, reverse fault (fig. 57), which forms the contact between the predominantly gneissic rocks of the Coyote Mountains (Kurtz, 1955) and the predominantly granitic rocks of the Quinlan Mountains (Wargo, 1954; and Wargo and Kurtz, 1956). At 3:00, low hill of tilted granite and gneiss boulder conglomerate composed of fragments. This conglomerate is probably late Tertiary, and is well exposed in a road cut 0.6 miles west. There are, in this general area, at least one older Tertiary alluvial unit and two younger Tertiary and Quaternary alluvial units, not including the most recent channel, flood-plain and adobe-flat deposits. There are also three bajada or dissected bajada surfaces: (1) The oldest forms the tops of the hills along the right of the road; (2) the second is less well developed locally but can be well seen across the valley between the North and South Comobabi Mountains in about 2.5 miles; (3) the third, and youngest, bajada is the one most prominently seen sloping from the mountains to the valleys. The third surface is now being dissected on its upper slopes.
1.2	41.0	New road at left is to Kitt Peak. This road eventually will be paved at a grade to allow ready access to the National Astronomical Observatory.
0.4	41.4	Road cut shows red-brown intrusive (?) rhyolite of probable Tertiary age, possibly a part of the silicic volcanic sequence exposed in the Roskruge Mountains.
0.7	42.1	At 3:00, dumps on the low hills are from manganese mines and prospects dug in

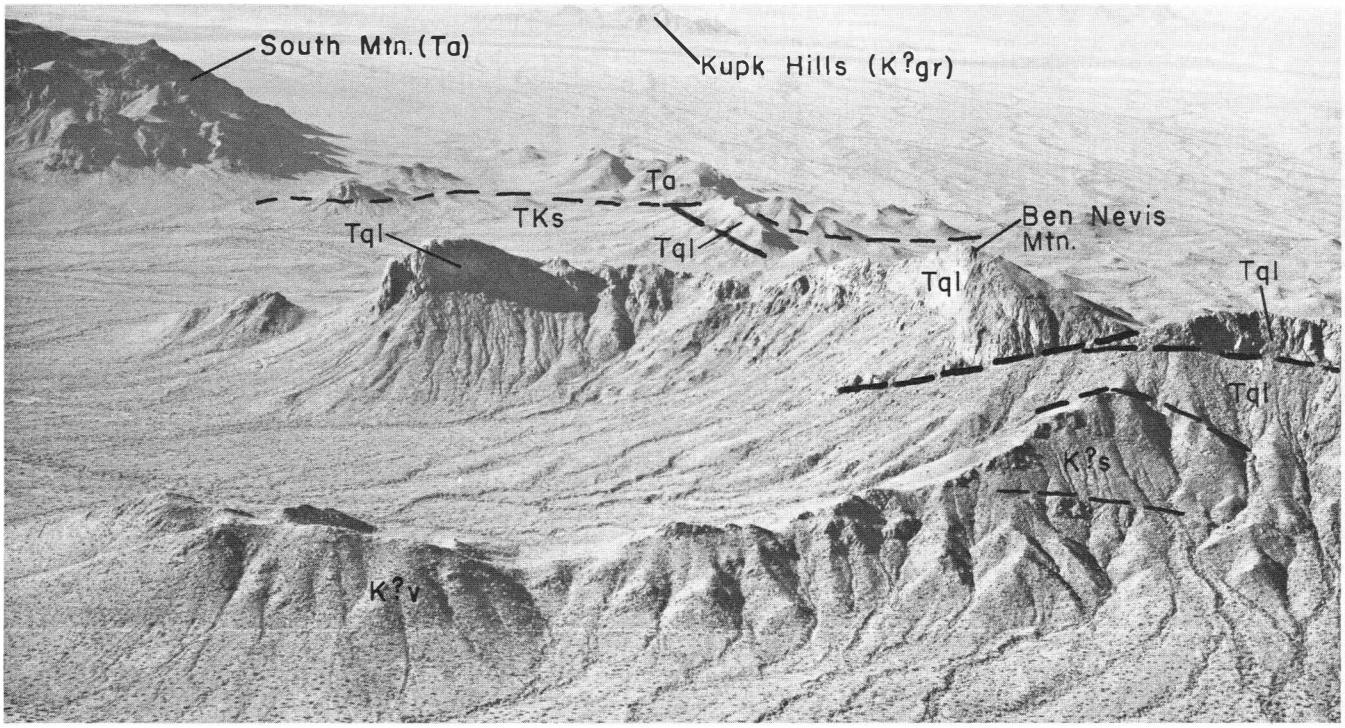
		the rhyolite. At 9:00, low hills are part of the granitic complex. The generally east-west trending Ajo Road fault crosses the highway beneath the alluvium in this vicinity. At left of road, typical Papago charco (dirt tank) and corral.
0.9	43.0	The view west and north, generally between 12:00 and 4:00, is down and across Aguirre Valley, a part of the Santa Cruz River drainage system. Between 12:00 and 1:30, on the skyline, are the South and North Comobabi Mountains (Bryner, 1958). Cross-section D-D' (fig. 59) extends from the north end of the North Comobabi Mountains south to the Artesa Mountains, which will be seen shortly. At 2:00, Gu Achi (big ridge) or Santa Rosa Peak, composed of phyllitic Cretaceous (?) continental strata, chiefly pebble to boulder conglomerate. At 2:30, the Vaca Hills, composed of a thin capping of andesitic and basaltic flows overlying a thick sequence of tuffaceous and alluvial sediments, which, in turn, lie on a moderately rugged surface cut on Tertiary (?) intrusive and volcanic rocks.
0.4	43.4	Road intersection. Road right leads to Schuck (Santa Rosa School) and Sil Nakya Hills at north end of cross section D-D'.
3.1	46.5	Northwest end of Quinlan Mountains, composed of granitic and pegmatitic rocks intruding Cretaceous (?) rhyolitic tuffs (?) and arkosic sediments.
1.2	47.7	At 1:30, view toward South Comobabi Mountains across an alluvial divide between the Santa Cruz River drainage, tributary to the Gila River to the north, and the San Simon Wash drainage, tributary to the Sonoyta River in Mexico. The well in the middle of the valley is at Haivana Nakya (crow hangs) Village on the drainage divide, which is also a ground-water divide. The depth to water is about 465 feet. As the road swings southwest, the Artesa Mountains come into view. These hills form the south end of cross-section D-D' and the west end of cross-section C-C' (fig. 59).
0.7	48.4	Road intersection. Road right to Haivana Nakya; road left goes along the west front of the Baboquivari Mountains.
0.5	48.9	At 9:00, Baboquivari Peak. Cross-section C-C' (fig. 58) extends from the ridge to the left of Baboquivari Peak, across Baboquivari Valley to the Artesa Mountains.
3.4	52.3	Milepost 123. At 11:00, distant hills on southern skyline are mostly in Mexico.
0.8	53.1	Milepost 122. There is only 0.85 mile between mileage markers 122 and 123, probably as a result of a philosophic consideration of significant figures on a hot afternoon.
1.2	54.3	Highway skirts village of Chiawuli Tak (barrel cactus sits), on right side of road. The spread-out houses, neatly kept up, are typical of Papago villages. This village, which parallels the highway for 0.8 miles, contains about one dozen houses.
2.0	56.3	At 3:00, low hills, composed of andesitic flows, are an eastern extension of a series of north-dipping andesitic flows which form the north ridge of Artesa Mountains (fig. 59, D-D'). Lithologically similar flows crop out on the west side of the Baboquivari Mountains (fig. 59, C-C').
3.0	59.3	Charco at right of road. In the road cut immediately ahead, an andesitic dike cuts Tertiary (?) basalt flows. Leave area shown on figure 57.
1.8	61.1	Road intersection. Main road into Sells turns left.

SELLS SIDE TRIP

	0.0	TURN LEFT from State Highway 86 at mileage 61.1.
0.3	0.3	TURN RIGHT. Papago Tribal Rodeo grounds and offices on right; Bureau of Indian Affairs garages and maintenance buildings at left.

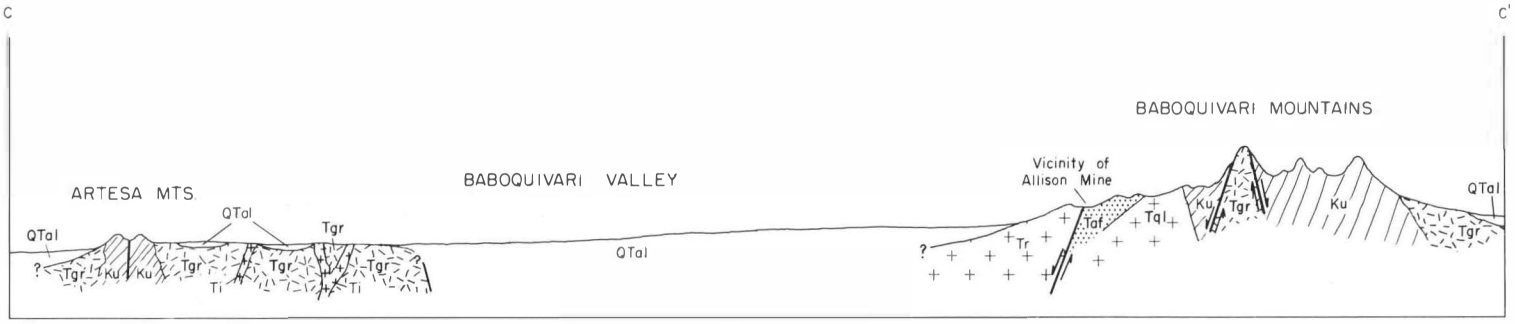


A. View southeast toward Baboquivari Mountains and Baboquivari Peak. Tertiary volcanic rocks (Tr), granite (Tgr), and "Fresnal" conglomerate (Tf); Cretaceous (?)-Tertiary (?) conglomerate, arkose, and shale (KTs).

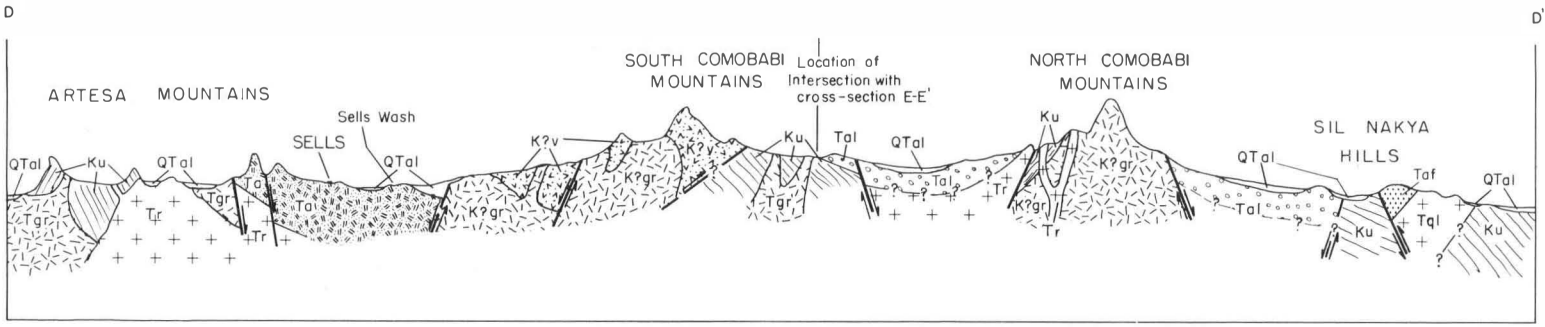


B. View looking southwest across Quijotoa Mountains between South and Ben Nevis Mountains. Cretaceous (?) volcanic rocks (K?v), sedimentary rocks (K?s); Cretaceous-Tertiary (?) intrusive and metamorphic rocks (K?gr); Cretaceous-Tertiary (?) sedimentary rocks (TKs); Tertiary quartz latite (Tql) and andesite (Ta).

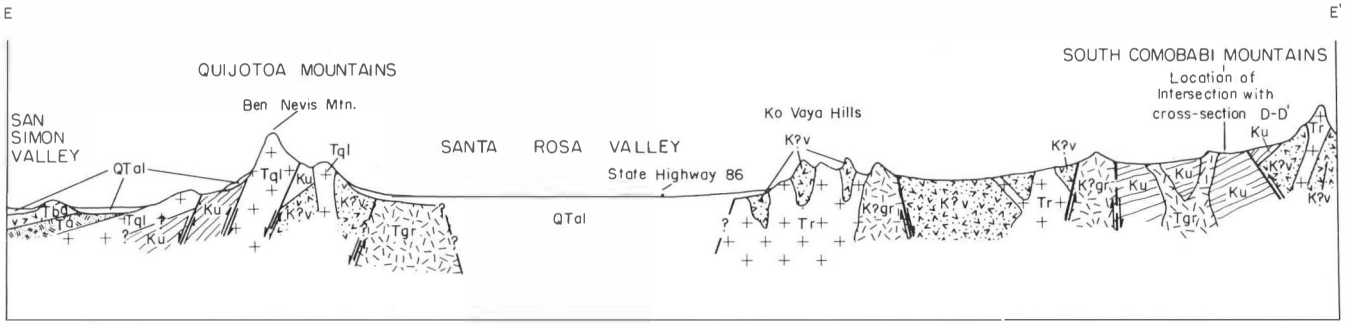
FIGURE 58. Aerial views of Baboquivari Mountains and Ben Nevis Mountain, Pima County, Arizona. Photos by Tad Nichols.



Cross-section C-C' trends generally N. 10° W. and is viewed looking south between Field Trip VI mileages 46.5 and 56.3; approximate length of cross section, 26 miles.



Cross-section D-D' trends generally N. 15° E. and is viewed looking west between Field Trip VI mileages 43.0 and 56.3; approximate length of cross section, 27 miles.



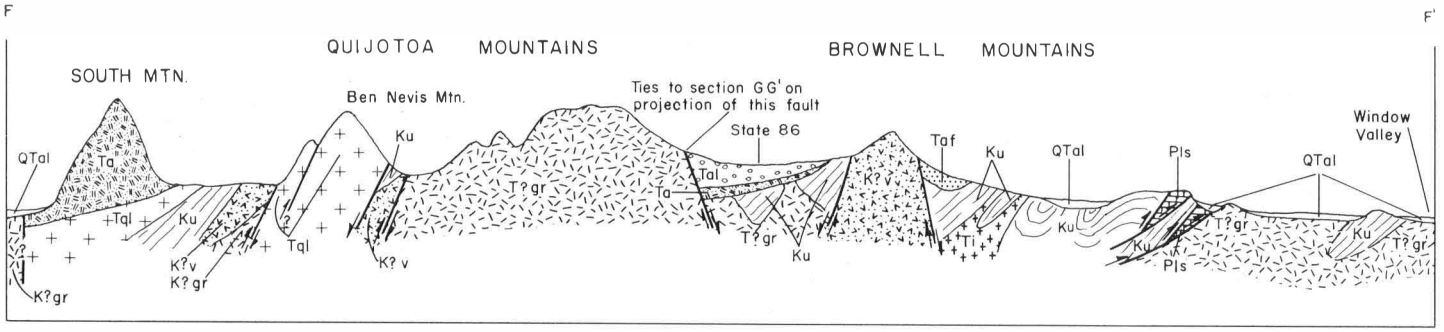
Cross-section E-E' trends generally east-west and is viewed looking north between Field Trip VI mileages 61.8 and 78.1; approximate length of cross section, 23 miles.

FIGURE 59. Diagrammatic cross sections C-C', D-D', and E-E' to accompany Field Trip VI (fig. 55). Cross sections are not to scale; vertical exaggeration is approximately x5.

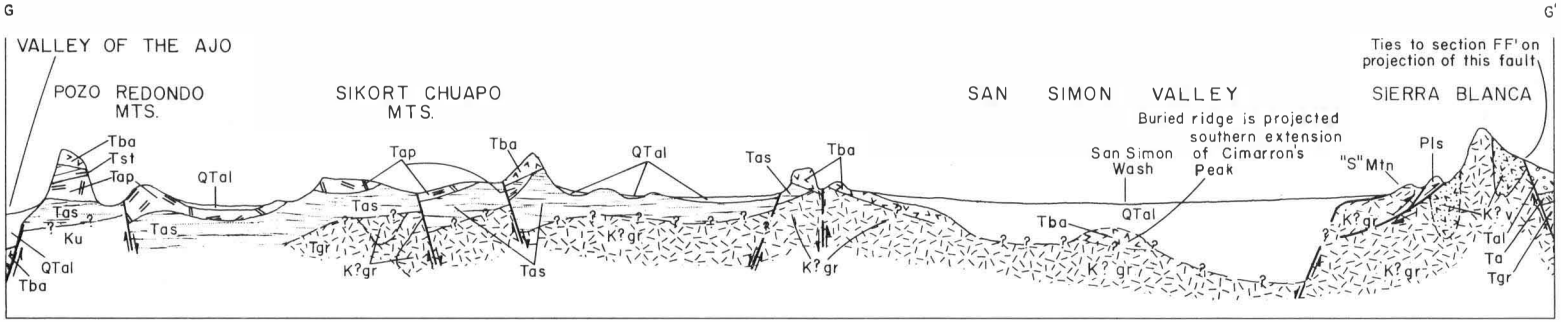
0.3	0.6	Trading Post at right; main entrance to Sells Indian Agency headquarters area at left.
0.2	0.8	TURN RIGHT; road to left goes to Topawa, San Miguel, and other villages.
0.1	0.9	On left, post office and trading post buildings sit on hill composed of andesitic flows.
0.1	1.0	Sells Wash.
0.1	1.1	Road to left leads to Gu Oidak (Big Fields), swings toward the Kupk Hills around the south end of South Mountain, and then turns north to join State Highway 86. Past Big Fields this road can be followed to Pisinimo only with difficulty. From Pisinimo the road is graded to State Highway 86, rejoining it either at mileage 93.1 or, by way of Kerwo, at mileage 117.7.
0.3	1.4	Rejoin Ajo-Tucson Highway at mileage 61.8.

END OF SELLS SIDE TRIP

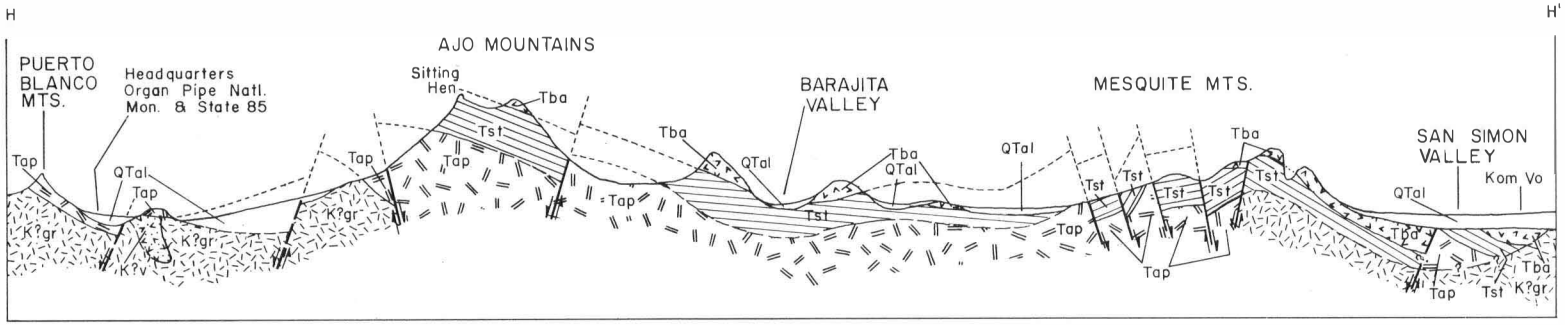
0.3	61.4	Bridge over Sells Wash. Andesite flows crop out in bottom of wash and form low hills on south side of highway.
0.4	61.8	Road intersection: Left to Sells, and right to Sells Airstrip and Cobabi mining district (MacKellar, 1958; Bryner, 1958) in the Ko Vaya Hills.
2.4	64.2	At 9:00, the Great Plain, a broad alluvium-covered bajada that slopes continuously from the Baboquivari Mountains past the Artesa Mountains to San Simon Wash. It drains into the Sonoyta River, Mexico (figs. 1, 55).
2.2	66.4	Highway passes through Etoi-Ki Hills, composed of agglomerate, welded tuff, and volcanic flows of probable late Tertiary age.
1.0	67.4	On the central three knobby hills on right of highway are prehistoric Indian terraces which can be seen below the capping flow.
1.9	69.3	Shallow curve around base of hill composed of basaltic andesite flows. Start 13-mile straightaway. At 9:30, the Kupk Hills are outlined against the Mesquite Mountains. The Kupk Hills are composed of granitic and gneissic rocks of Mesozoic (?) age. At 10:00, South Mountain, composed of andesitic flows (fig. 60, F-F'). Cross-section F-F' includes the mountains seen on the left side of the road along the straightaway. At 11:00, Ben Nevis Mountain (fig. 58). A complex fault pattern in this mountain gives it the appearance of a deformed and deeply dissected ring-dike. The mountain is composed of altered and unaltered Cretaceous (?) sedimentary and volcanic rocks, and several units of Tertiary volcanic and sedimentary rocks. At 11:00 to 12:00, the Quijotoa Mountains, a massive block of quartz monzonite, readily identified by its lighter color where it is in fault contact with the Cretaceous (?) volcanic and sedimentary rocks of Ben Nevis Mountain. At 12:00, Brownell Mountains (fig. 60, F-F'), composed of Cretaceous (?) and Tertiary (?) intrusive volcanic and sedimentary rocks. At 1:00, Cobabi Hills on the west flank of the South Comobabi Mountains (MacKellar, 1958). Cross-section E-E' (fig. 59) shows the general relationships between the Comobabi Mountains to the east and the Quijotoa Mountains and San Simon Valley to the west.
8.8	78.1	Dip. This wash drains south. A short distance north, the valley is drained north by Santa Rosa Wash. The maximum thickness of alluvium is not known for any of the larger alluvial valleys of the Papago Indian Reservation, but it is known to be at least 1,000 feet thick at several points. Depth to water at this point is about 400 feet. Elsewhere in the area, depth to water in the larger alluvial valleys ranges from about 100 to about 600 feet.



Cross-section F-F' trends generally N. 10° E. and is viewed looking west between Field Trip VI mileages 69. 3 and 87. 3; approximate length of cross section, 26 miles.



Cross-section G-G' trends generally N. 75° W. and is viewed looking north between Field Trip VI mileages 87. 3 and 120. 5; approximate length of cross section, 30 miles.



Cross-section H-H' trends generally N. 80° W. and is viewed looking north; approximate length of cross section, 28 miles. The section can be observed intermittently between Field Trip VI mileages 94. 7 and 145. 9.

FIGURE 60. Diagrammatic cross sections F-F', G-G', and H-H' to accompany Field Trip VI (figs. 55, 61). Cross sections are not to scale; vertical exaggeration is approximately x5.

1.8	79.9	Radar (?) station.
2.1	82.0	Road left to abandoned Quijotoa mining camp (Gebhardt, 1931).
0.4	82.4	End of 13-mile straightaway.
1.1	83.5	Curve marks the beginning of the Covered Wells Pass, about 8 miles of winding road. Look out for curves, cows, and cars. The hill on right is composed of altered, mineralized rhyolite, which may be of Cretaceous (?) age, and possibly correlates with the Concentrator volcanics at Ajo (Gilluly, 1946).
0.3	83.8	Road right goes to Chuichu (pronounced Choo-choo) Village and Casa Grande. Chuichu is sometimes spelled Chuichiushu, which is also pronounced Choo-choo. Chuichu includes a 1,200-acre modern irrigation development operated by Papago Indians under the guidance of the Bureau of Indian Affairs.
0.6	84.4	Large wash. Quijotoa Village, one of the larger Papago villages, on left. Points of interest in the next mile are the cemetery and Catholic Mission and school buildings on the left.
0.9	85.3	Covered Wells Trading Post on right. This is one of six trading posts on the reservation. Some of the trading posts, as an added service, operate mobile stores which make regular runs to distant communities.
0.6	85.9	On the left in the wash are outcrops of mafic volcanic rocks of possible Cretaceous age which are intruded by quartz monzonite.
0.5	86.4	From this point, for the next 0.9 mile, the road passes through a sequence of alluvial sediments, with a single interbedded andesitic flow near their base, which dip west at about 20°. There are several units of older, deformed alluvial deposits in the region, which cannot be correlated accurately at this time because of a lack of fossils or other evidence. The great thicknesses of alluvium reported from some basins possibly may include several sequences of alluvial deposits.
0.9	87.3	The road here crosses the approximate location of a large normal northwest-trending fault along which the alluvial deposits are in contact with the quartz monzonite (fig. 60, F-F' and G-G').
0.3	87.6	At 1:00, Sierra Blanca Mountains, an offset continuation of the quartz monzonite of the Quijotoa Mountains which passes northwest into granitic gneiss and other metamorphic rocks.
0.9	88.5	View straight ahead across San Simon Valley. On a clear day it is possible to see smoke from the smelter at Ajo at about 12:30.
2.7	91.2	At 11:00, prominent black hill is the largest of cluster of hills composed of probably late Tertiary andesitic and basaltic flows. Similar flows flank or cap many ranges in this region.
1.9	93.1	Road at left leads to the village of Pisinimo. Enter area shown on figure 61.
1.1	94.2	Road to right leads to silica quarry, dug in Paleozoic (?) quartzite which is part of a small thrust sliver (fig. 60, G-G'). The hill north of the quarry is composed of a sliver of Paleozoic limestone (fig. 62A) and is the westernmost Paleozoic rock known between here and the Growler Mountains (Wilson in McKee, 1951). Cimarron Peak at 2:30.
0.5	94.7	At 9:30, in the distance, are the Mesquite Mountains, distinctive because of their corrugated flat top. They are composed of volcanic and alluvial rocks that are folded and faulted into a ruptured, north-plunging anticline. The Mesquite Mountains are shown at the east end of cross-section H-H' (fig. 60), which continues westward through the Ajo Mountains at 11:00.
2.7	97.4	Radar (?) station at left.
0.8	98.2	Begin 11-mile straight stretch across San Simon Valley to Nine-Mile Peak, which

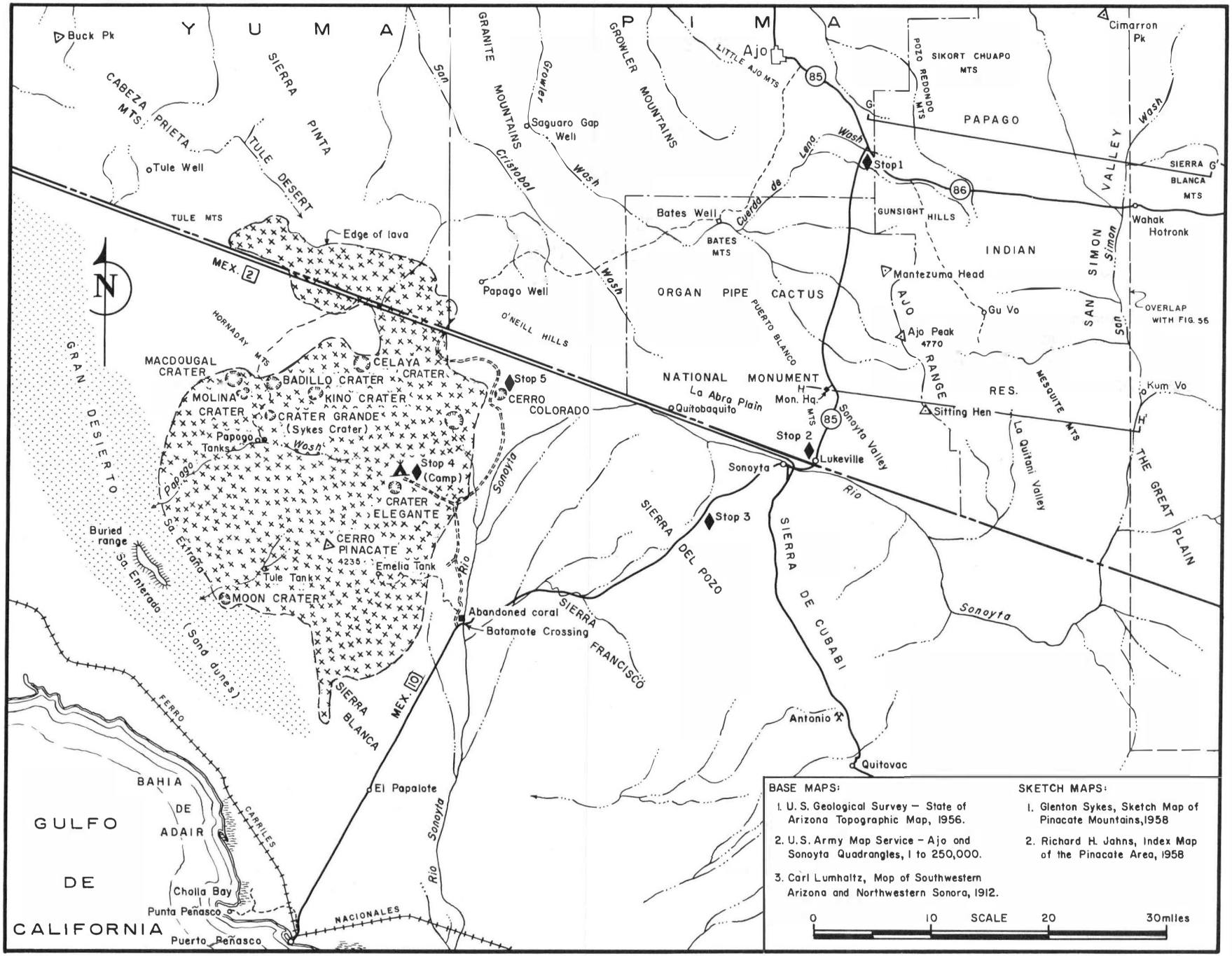
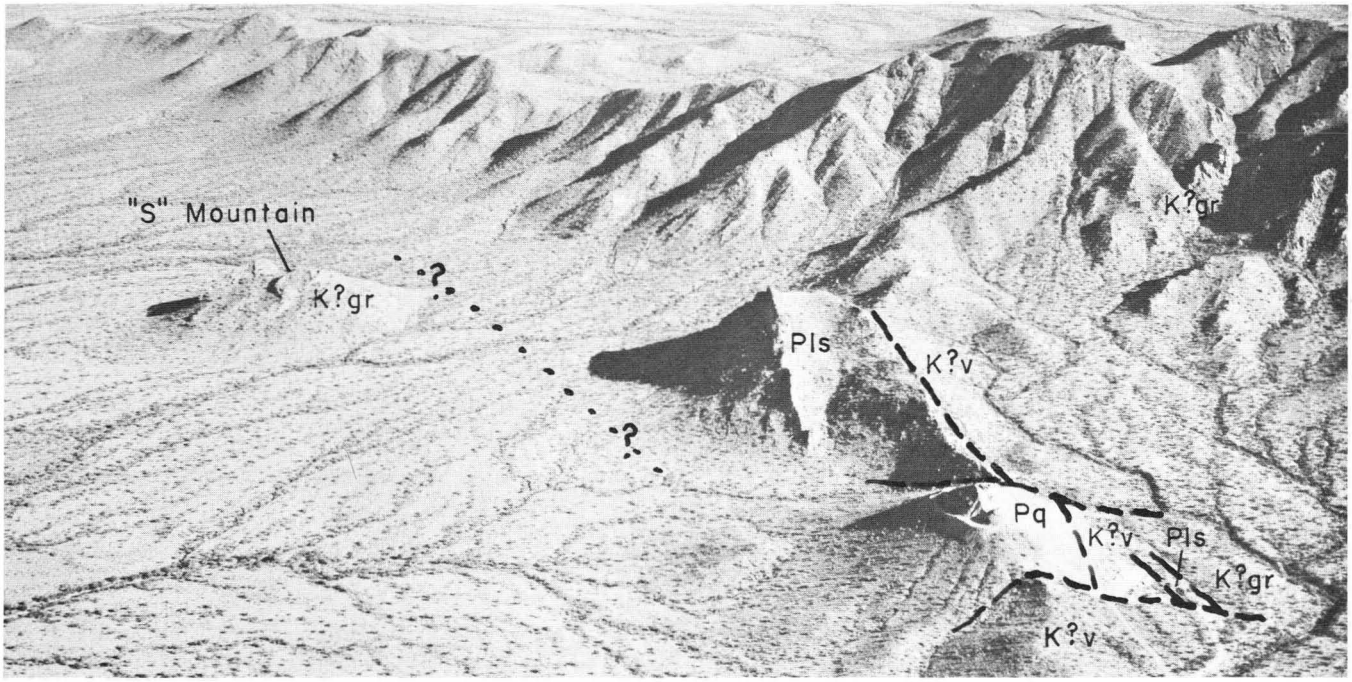


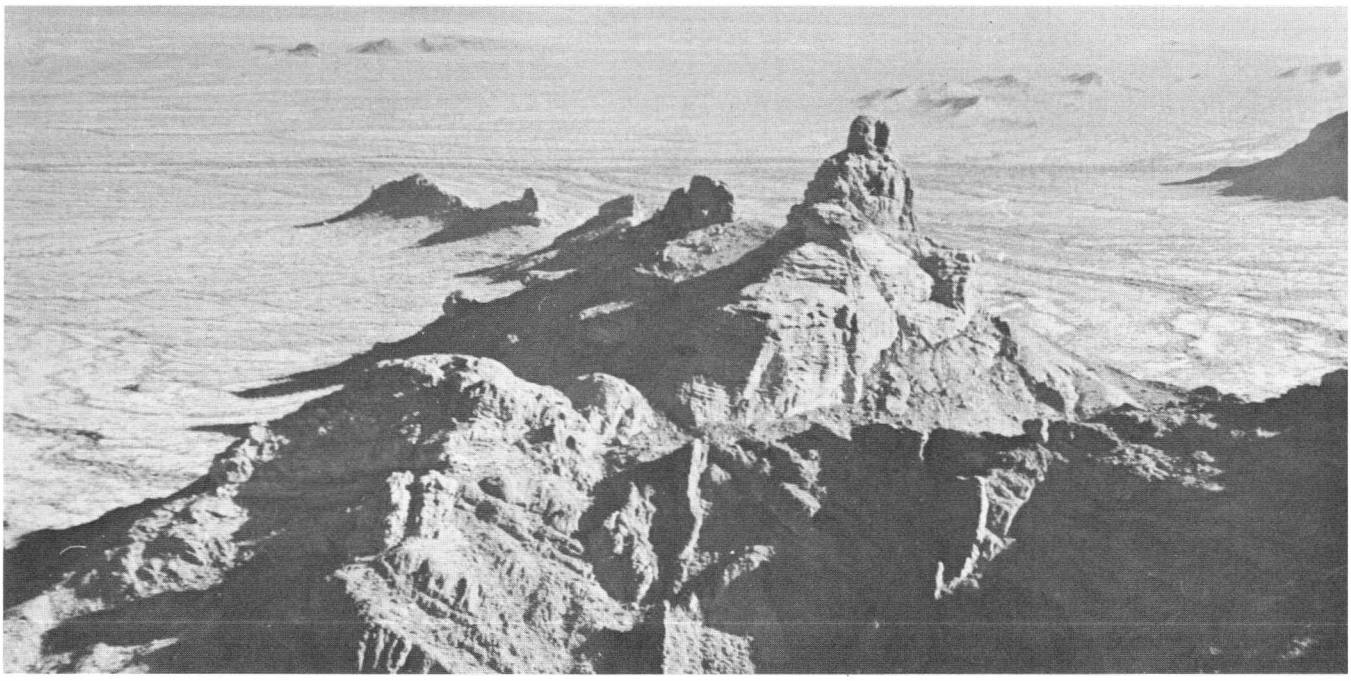
FIGURE 61. Index map of part of southwestern Arizona and northwestern Sonora, Mexico, showing route of west half of Field Trip VI, the location of the Pinacate Mountains, and generalized locations of diagrammatic cross sections shown in figure 60.

		can be seen immediately to the left of the road, 11 miles away.
1.0	99.2	Village of Wahak Hotrontk on left. Tracy's Trading Post is 0.5 mile ahead on the left side of the road. Leave area shown on figure 55.
1.9	101.1	Cimarron Peak at 3:00. The geology of this mountain is characteristic of many of the ranges in this area. The volcanic pile is built up on an eroded surface cut on Cretaceous (?) volcanic and sedimentary rocks which have been intruded and altered or metamorphosed. Older rocks of Precambrian and Paleozoic age have not been recognized between the Sierra Blanca and Growler Mountains, although they may be present as septa within younger intrusive rocks. The Tertiary volcanic rocks consist of four sequences (table 6) which locally may interfinger, pinch out, or be separated by angular unconformities. The Sneed andesite, Childs latite and Batamote andesite in the Ajo quadrangle (Gilluly, 1946), 25 miles west, are the probable equivalents, in part, of three of the four units recognized in this area.
2.1	103.2	From 10:00 to 11:00, the low prominent ridge jutting eastward into the San Simon Valley is the gneissic and granitoid core of a broad anticline that forms the Gunsight Hills. Its flanks are edged with at least two sequences of volcanic rocks which have been involved in the anticlinal warping.
3.1	106.3	Near this point the road crosses the approximate line that marks the break between deep and shallow alluvium. The line runs roughly between the last point of the Gunsight Hills to the left and east flank of the hills seen at 2:00. Along the central part of San Simon Valley, the alluvium is known to be locally more than 800 feet deep. To the northwest the broad plain ahead is underlain by gneissic, granitic, and volcanic rocks at depths of generally less than a few hundred feet. Toward the head of the valley, bedrock is exposed irregularly in low hills and hummocks. The surface of the bedrock appears to be eroded to about the same extent on granitoid and on volcanic material.
0.6	106.9	At 9:00, gneissic and granitic hills. Note weathering characteristics of these rocks - intricate fracturing, steep slopes, and rubble-free base.
0.7	107.6	Road to left leads to a silica quarry located in quartz veins cutting gneissic rocks. The silica was for the smelter at Ajo.
0.3	107.9	At 3:00, low hills of contrasting light- and dark-colored rocks are composed of late Tertiary (?) dark-colored andesitic flows capping light gray gneissic rock. These hills are shown about at the center of cross-section G-G' (fig. 60).
1.0	108.9	Nine-Mile Peak at left. Nine miles back to Tracy's Trading Post and nine miles to the road to Menager's Dam. Nine-Mile Peak is composed of andesite flows which are part of the oldest Tertiary (?) sequence, recognized in this general vicinity.
0.4	109.3	End of 11-mile straightaway.
0.8	110.1	At 11:00, the Buddha-like figure at the north end of the Ajo Mountains is known as Montezuma Peak (fig. 62B). It is sculptured in a downthrown block of intermediate volcanic flows and pyroclastic rocks.
1.4	111.5	Road to right leads to villages in the northwestern part of the Papago Reservation. Ventana Cave, about 20 miles northeast of here, is the site of a well-known archeological dig. The cave midden showed nearly continuous human habitation for at least 10,000 years. Extinct forms of dyer-wolf, jaguar, ground sloth, and tapir are associated with the earliest artifacts, and remains of Say's ground squirrel suggest a markedly cooler climate (Haury, 1951).
3.6	115.1	Road to right leads to village of Hotoson Vo, one of the last communities on the reservation without ready access to well water. North of Hotoson Vo, the volcanic rocks lie in a broad, shallow, faulted syncline whose west flank is at the north end of the Pozo Redondo Mountains and whose east flank is faulted against the Sikort Chuapo Mountains (fig. 60, G-G').
1.1	116.2	At 9:00, the low discontinuous hills in the foreground are composed of volcanic

		flows on the north flank of the Gunsight anticline. At a greater distance, the moderate east dip of the volcanic rocks of the Ajo Mountains can be readily seen. The Ajo Mountains are composed of fault blocks whose structural pattern suggests a broad, collapsed anticlinal warp (fig. 60, H-H'). At 10:00, prominent light-brown hills are of post-Cretaceous (?) quartz monzonite that has been extensively prospected and locally mined. At 1:00, the volcanic flows in south end of the Pozo Redondo Mountains dip west.
1.5	117.7	Intersection nine miles from Nine-Mile Peak. Road to left leads to Kerwo and Menager's Dam; road to right goes north into the Pozo Redondo Valley.
0.3	118.0	Road cut in andesitic flows.
0.7	118.7	The west dips of the volcanic flows of the Pozo Redondo Mountains are well exposed on the right.
0.4	119.1	At 10:00, flat-topped hills are composed of andesitic flows lying unconformably on tilted flows of older andesitic porphyry flows. Discontinuous lenses, ranging from a few feet to several hundred feet thick, locally underlie the upper flows.
0.9	120.0	The road gradually curves to the northwest and the Little Ajo Mountains and the Ajo smelter and tailings dump can be seen at 12:00. The geology of the Ajo mining district was mapped by Gilluly (1946).
0.5	120.5	The flat-topped hill at 2:00 is at the west end of cross-section G-G' (fig. 60).
0.7	121.2	Cattleguard. Leave Papago Indian Reservation.
1.6	122.8	CUATION. Approaching junction of State Highways 86 and 85. TURN LEFT into gas station for STOP 1. Ajo is straight ahead. The small hill north of the junction has three of the four volcanic units recognized in this area. Following gassing up and coffee, proceed left toward Lukeville and the Mexican boundary.
0.2	123.0	CAUTION - merging traffic from Ajo. The Valley of the Ajo (Spanish for garlic or wild onion) is on the right. The Growler Mountains at 3:00 are composed principally of volcanic rocks but include a small area of altered Paleozoic sedimentary strata.
2.9	125.9	At the south end of the volcanic hills on the left are good exposures showing the essentially horizontal overlying alluvial lenses and tilted flows of andesite porphyry, which is nearly everywhere covered by scree from the capping flows.
1.7	127.6	Enter Organ Pipe Cactus National Monument.
1.1	128.7	On the left of the road, an organ-pipe cactus - raunchy but untransplanted.
1.0	129.7	At 2:00, Bates Mountain.
4.1	133.8	At 10:00, the small hill in the middle distance surrounded by alluvium is composed of mineralized coarse-grained granite.
1.9	135.7	Road cuts in hills of welded tuff-agglomerate.
5.0	140.7	Road cuts in hills of spherulitic vitrophyre agglomerate and associated spherulitic rocks.
2.2	142.9	Road cuts in vesicular andesite (?) with a spotty, nearly porphyritic texture. There appears to be a gradational series from spherulitic to porphyritic textures in these rocks.
		There are many organ pipe cactuses along the road for the next few miles.
0.5	143.4	Road cut in andesite porphyry. This rock is texturally similar to the Childs latite described by Gilluly.
0.9	144.3	At 2:00 and 4:00, the slopes of the Puerto Blanco Mountains are composed of bluish-gray intrusive rocks capped by flows of andesite porphyry dipping to the



A. View looking northwest across north end of Sierra Blanca Mountains, showing "S" Mountain and slivers of Paleozoic limestone (Pls) and quartzite (Pq) in thrust fault contact (fig. 61, G-G') with metamorphosed Cretaceous (?) strata (K?v) and Cretaceous-Tertiary (?) intrusive and metamorphic rocks (K?gr).



B. View, looking northeast, of Montezuma Head, a small fault block composed of Tertiary bedded pyroclastic deposits at the north end of the Ajo Mountains. Note the many nearly vertical dikes of andesite. The small hills to right of and above Montezuma Head are the granitic core of the Gunnison Hills anticline.

FIGURE 62. Aerial views of the Sierra Blanca and Ajo Mountains, Pima County, Arizona. Photos by Tad Nichols.

		east. These hills form the west end of cross-section H-H' (fig. 60).
0.3	144.6	Prominent mountain mass at 12:00 is in Mexico. At 9:00, brown andesite porphyry flows are in depositional contact on light gray intrusive rock.
0.1	144.7	Road right leads to Organ Pipe National Monument headquarters.
1.2	145.9	The Ajo Mountains form the skyline on the left. At the foot, Sitting Hen, the prominent peak at 9:00, is a small exposure of granite, shown in cross-section H-H' (fig. 60).
0.6	146.5	At 3:00, intrusive and metamorphic rocks continue southward forming an almost unbroken ridge from the Puerto Blanco Mountains in Arizona to the Cubabi Mountains in Sonora, Mexico.
3.5	150.0	At 9:00, factory-like building is an old ice house from which ice was at one time supplied for the shrimp fisheries at Puerto Penasco, Mexico.
0.2	150.2	Lukeville: STOP 2. U. S. Customs and Immigration Station at the United States-Mexico boundary (altitude on road is 1,390 feet).
0.7	150.9	At 10:00, Sierra Cubabi, composed of a crystalline complex. Road note: "Vado" means "Dip."
0.9	151.8	Road cut in phyllite formed by low grade metamorphism. Original materials include tuffaceous material welded tuff and other pyroclastic debris. Locally the tuffaceous rocks contain fragments of quartzite and other clastic grains. Note difference between effects of deformation in this outcrop and on the unaltered sill 300 feet to west. Four hundred feet further along the road west, the tuff is highly sheared and intersected by a 21-inch quartz vein.
0.5	152.3	Road forks. Intersection with Sonora Highway 2 to San Luis. TAKE LEFT FORK. "Alto" means "Stop."
0.1	152.4	Road crosses bridge.
0.1	152.5	Intersection: Hermosillo-Puerto Penasco road; TAKE RIGHT FORK on Sonora Highway 10.
0.2	152.7	Slow - entering town of Sonoyta.
0.7	153.4	Immigration check station. Remain in cars.
1.0	154.4	Road cuts in Tertiary-Quaternary alluvium.
1.0	155.4	Between 9:00 and 10:00, Sierra Cubabi. Altitude on road at this point is 1,320 feet.
0.6	156.0	Angular boulders of metagranite in road cut. Metagranite has undergone feldspathization with the formation of large orthoclase and microcline crystals. Locally, deformation has developed a gneissic structure. Metagranite is cut by aplite dikes and contains dikes and pods of pegmatite. Andesite (?), minette, biotite schist, and other rock types are also present as isolated blocks.
0.4	156.4	At 3:00 to 5:30, good view of the Growler and Puerto Blanco Mountains.
1.5	157.9	Kilometer 12 marker on road.
2.2	160.1	STOP 3. At 3:00, contact between phyllite derived from clastic and volcanic debris and "granophyric" granite. At 9:00, a gradation is observable going up rise from phyllite to gneissic rocks (derived from sheared granitics).
0.1	160.2	Outcrop of phyllite similar to that at STOP 3 but containing visible elongated ellipsoidal pebbles. At 12:00, granitoid mass.
3.0	163.2	Adobe house (ready for occupancy - low rent!).

0.7	163.9	At 9:00, coarsely crystalline muscovite granite, transected by pegmatite. Three of the largest cacti native to the area grow in this vicinity. The organ-pipe cactus has close fluting in contrast to the senita cactus which has wide fluting. Sahuaro cactuses are abundant.
2.1	166.0	Kilometer 25 marker. First clear view of Pinacate Mountains at 2:00. Around bend at 12:00 are sand dunes. Altitude on road is about 1,200 feet. Road descends steadily at rate of about 40 feet per mile.
5.4	171.4	Sand dunes can be seen to lap completely around this side of the Pinacate volcanic field.
1.6	173.0	At 10:00, mountain range.
0.8	173.8	Kilometer 37 marker. At 10:00, high hill consists of boulder conglomerate underlying a capping of andesite and basalt flows. Low rounded mounds in foreground consist of spherulitic rhyolite with glass blebs and strings with well developed flow structure.
0.6	174.4	Entering area of sand dunes.
2.2	176.6	Rounded mound at 9:00 consists of rhyolite.
0.6	177.2	Passing outcrops of spherulitic quartz latite and rhyolite.
1.7	178.9	Kilometer 45 marker.
0.4	179.3	Rhyolite, partly brecciated, with well-developed flow structure and visible free quartz.
2.7	182.0	Basalt flows to left and right of road.
1.0	183.0	Kilometer 51 marker. Altitude on road at this point is about 580 feet.
0.2	183.2	First of two bridges over Sonoyta River. SLOW. Prepare to turn right.
0.5	183.7	TURN RIGHT.
0.1	183.8	Go around left side of watering trough and corral and head north on dirt trail.
0.4	184.2	Road forks. TAKE LEFT FORK.
0.9	185.1	TAKE LEFT FORK.
1.7	186.8	Road forks. TAKE RIGHT FORK toward point of basalt flow.
0.4	187.2	Road forks. TAKE RIGHT FORK. Left fork goes toward Emelia Tanks.
0.8	188.0	At 9:00, excellent view of Pinacate Mountains.
0.5	188.5	Pass branch road at 9:00; continue straight ahead (north).
0.9	189.4	Outcrops of apparently intrusive andesite to right of road.
1.1	190.5	Andesite with nearly vertical planar orientations. View at 11:00 of intrusive (?) body capped by volcanics. Altitude on road is about 580 feet.
0.1	190.6	At 12:00, reddish tan mound is Cerro Colorado. At 2:00, beyond Cerro Colorado, are the O'Neill Hills, which are north of the United States-Mexico boundary.
0.4	191.0	At 10:30, Crater Elegante is the low indistinct mound lying short of a lone black knob on skyline. Note symmetrical cinder cone at 9:30 and cluster of cones at 10:00.
0.9	191.9	Road forks. TAKE RIGHT FORK. 100 feet farther, road forks again. TAKE LEFT FORK to Elegante.

1.5	193.4	At 12:00, Cerro Colorado.
0.8	194.2	Lone Teddy Bear cactus to right of road.
0.8	195.0	Road forks; TAKE LEFT FORK to Elegante. Right fork goes to Cerro Colorado.
0.8	195.8	Passing line of trees to left along a wash.
1.3	197.1	Basalt squeeze-ups on left side of road. At 3:00, Cerro Colorado is visible but partly obscured by volcanic rocks in foreground. Altitude on road is about 680 feet.
0.4	197.5	At 9:00, red cinder cone is Dos Mujeres (Two Women).
0.3	197.8	Basalt squeeze-ups on either side of road. The Dos Mujeres cinder cone is flanked by well-stratified cinder and sand beds.
0.4	198.2	Note common occurrence of senita cactus and ironwood trees growing in the same small area.
0.7	198.9	Lava flow outcrops to right of road. Route crosses thinly-covered flows.
0.8	199.7	Road forks. TAKE RIGHT FORK. Altitude at this point is about 820 feet. Road climbs up on lava flow.
1.0	200.7	ENTER CAMPSITE. Following lunch, the party will examine Crater Elegante.

VOLCANIC CRATERS OF THE PINACATE MOUNTAINS, SONORA, MEXICO

TRIP VI, ROAD LOG

(Continued)

Second Day, Monday, April 6, 1959

Leaders: F. W. Galbraith, L. A. Heindl, and G. G. Sykes

Driving Distance: 207.7 miles Logged Distance: 55.4 miles

General Statement:

The party will examine Cerro Colorado during the morning and return to Sonoyta, Sonora, via Sonora Highway 2. Following an informal stop at Sonoyta, the field trip will disband at Lukeville, Arizona.

0.0	0.0	Leave campsite.
2.5	2.5	Note bedded ash lapping up on Dos Mujeres.
3.2	5.7	Road forks. TAKE LEFT FORK to Cerro Colorado.
3.4	9.1	At 9:00, area of young basalt flow.
0.3	9.4	Area of young sahuaro cactuses to right.
1.6	11.0	Road forks. TAKE RIGHT FORK.
2.5	13.5	Basalt flow to left contains fresh phenocrysts of olivine and plagioclase. Foreblocks have slumped over and are standing vertically.
0.9	14.4	TURN RIGHT to Cerro Colorado.
0.3	14.7	STOP 5. Leave cars to examine Cerro Colorado.
0.3	15.0	Return to main dirt track. TURN RIGHT.
2.1	17.1	Playa beds on left are green with grass during rainy season.
0.3	17.4	Road forks. TAKE RIGHT FORK.
1.4	18.8	Road forks. TAKE LEFT FORK.
1.6	20.4	Side road emerging from left.
2.7	23.1	Biotite-quartz-microcline gneiss of metamorphic origin exposed on either side of road.
0.1	23.2	Intersection with Sonora Highway 2. TURN RIGHT to Sonoyta.
0.1	23.3	Hill on left side of road consists of muscovite-biotite paragneiss containing pegmatites, which is overlain by a tuffaceous and limy alluvial bed and capped by a basalt flow.
2.1	25.4	Basement rocks at 9:00; Cerro Colorado at 3:00 in the middle distance.
1.1	26.5	From 10:00 to 11:00, O'Neill Hills, composed predominantly of basement rocks.
4.1	30.6	Begin gentle S-curve.
2.8	33.4	Bridge over large wash. This is not the Sonoyta River.

0.7	34.1	Begin pass through basaltic hills capped by east-dipping cinder beds which possibly may be a remnant of an old volcanic cone.
0.3	34.4	White border monument and border fence can be seen about 200 feet to the left, north, of the highway. Note eroded alluvial fans on left.
3.3	37.7	Border monument.
1.2	38.9	House and well on United States side of border. Enter low hills composed of intrusive and metamorphic rocks.
1.8	40.7	Well and ramada (roofed-over, open-sided shelter) on United States side of fence on left.
2.4	43.1	Quitobaquito Springs on left, near cottonwood trees and houses. Quitobaquito Spring was one of the best-known watering spots in the desert during early explorations. Today the spring still flows about 10 gallons per minute from fractures in granitic rock. Three other springs are nearby within a couple of miles on either side of the range, each with a similar source.
0.3	43.4	Border monument.
0.2	43.6	Aguajita Wash.
2.2	45.8	Road cuts in sheared granitic rocks and metamorphosed phyllitic, tuffaceous, and clastic beds for about a half mile. Phyllitic materials are identical with those just southeast of Sonoyta at Stop 3.
2.3	48.1	Road cut on right in playa or adobe-flat deposits overlain by stream deposits lying on an erosional surface. These playa (?) deposits underlie much of the La Abra Plain, beneath a few feet or tens of feet of stream-laid deposits.
5.5	53.6	Curve to right. The Setting Hen of the Ajo Mountains can be clearly seen at 10:00 through the gap in the gray granitic hills.
0.3	53.9	Succession of road cuts in late Cenozoic materials. Note the wide variety of sedimentary structures.
0.9	54.8	Sonoyta, Mexico, from 12:00 to 2:00.
0.6	55.4	Caborca intersection. About one-half mile south on Caborca Road there is a rest stop. The road log mileage does not include the distance to this stop.
2.1	57.5	Lukeville, Arizona. The road log and field trip end at this point. Individual car parties may return to Tucson by the same route covered yesterday or may go west or north by way of Ajo.

SALUD Y PESETAS