OLD ROUTES TO THE COLORADO

compiled by

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Cover photograph: Parker Dam at the Colorado River. *R.E. Reynolds photograph*

Back cover map: from Map of the Saline Deposits of the Southern Portion of California. *G.E. Bailey, California Division of Mines Bulletin No. 24, 1902.*

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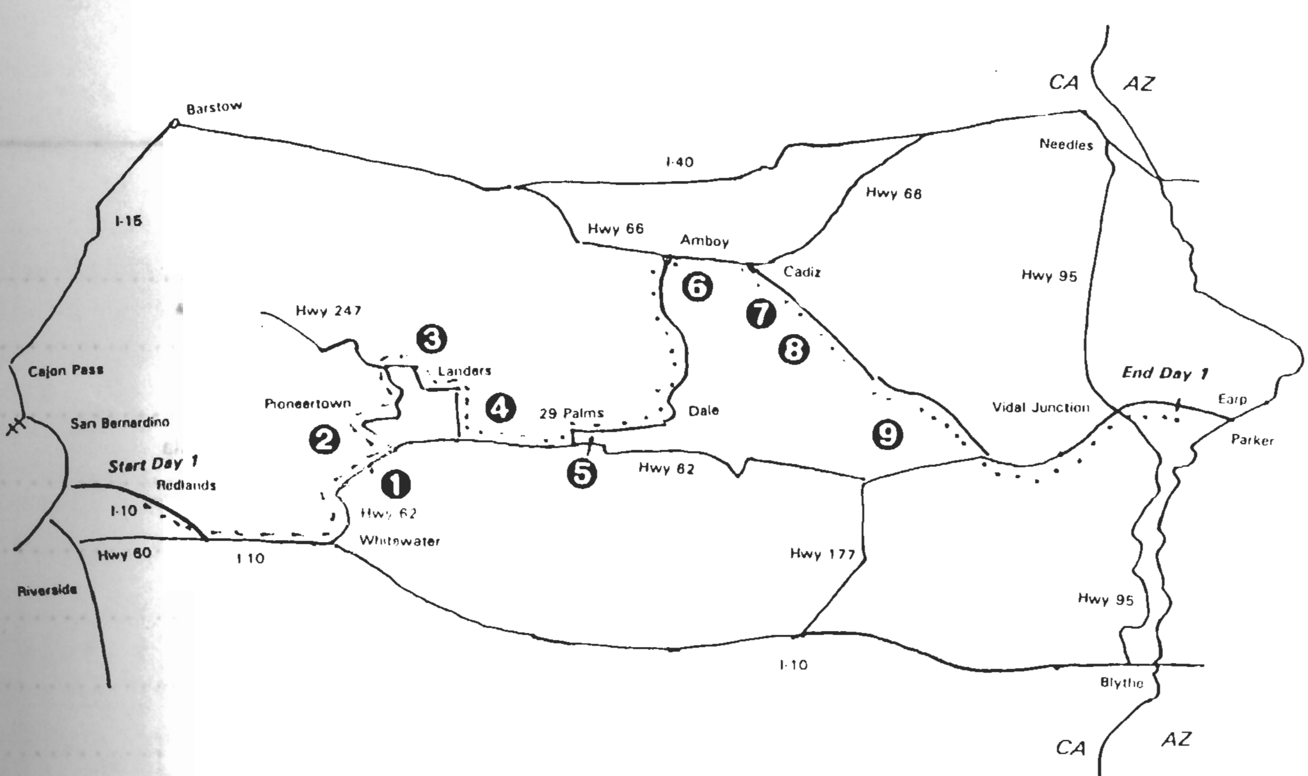

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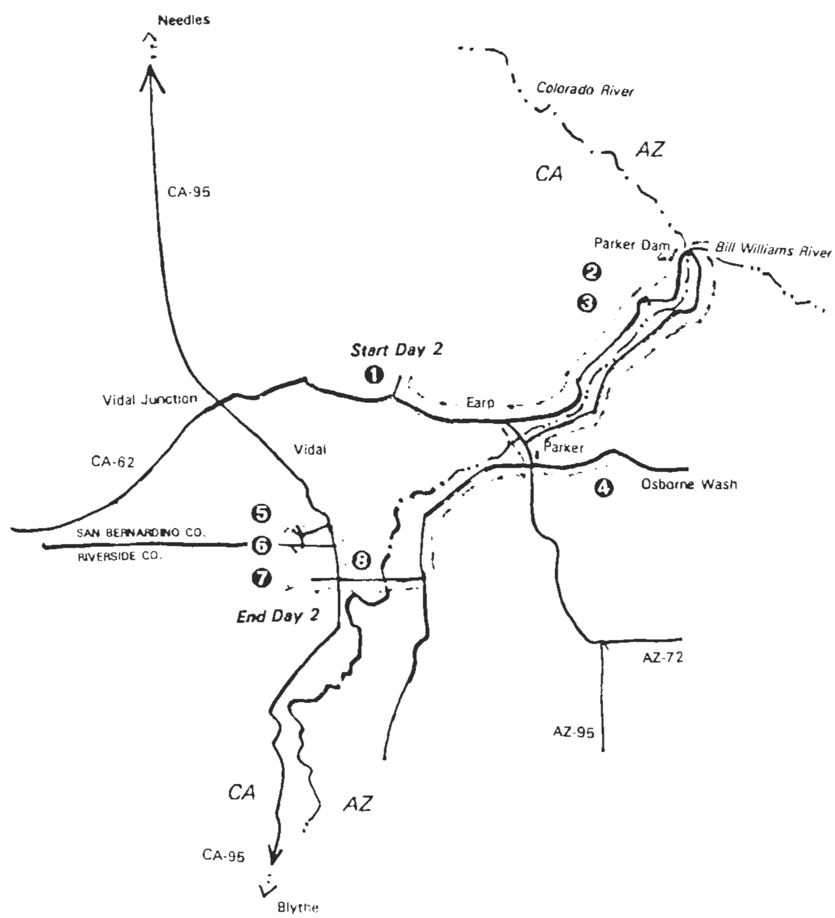

Day 2. The Colorado River Extensional Corridor

Old Routes to the Colorado

The 1992 Mojave Desert Quaternary Research Center Field Trip

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DAY 1

0.0 (0.0) START at the San Bernardino County Museum, 2024 Orange Tree Lane, Redlands. TURN RIGHT from parking lot entrance onto Orange Tree Lane, proceed to California Street.

0.2 (0.2) TURN LEFT at the stop sign onto California Street.

San Andreas Fault Segment

The San Andreas Fault system marks the boundary between the Transverse Range Province and the Penninsular Range Province. The right lateral San Andreas fault system, which includes the San Jacinto Fault to our south, controls the local geography and topography. We will be driving parallel to various components of the San Andreas system as we go southeast toward Palm Springs and Indio (Crowell, 1992).

0.4 (0.2) TURN LEFT onto Interstate 10 East, heading east toward Yucaipa and Palm Springs. Ahead you can see Yucaipa Ridge and San Bernardino Peak (elevation 10,525'). Yucaipa Ridge sits between the north branch (Mill Creek strand) and south branch (San Bernardino strand) of the San Andreas Fault.

Basement rocks similar to those found in the San Gabriel Mountains are overlain by the Mill Creek Formation where it is exposed on Yucaipa Ridge south of the mountain front. The Mill Creek Formation is a series of nonmarine Tertiary sediments deposited in a pull-apart basin (Demirer, 1985; Sadler and Demirer, 1986). The formation contains fossils which suggest an early Pliocene age (Axelrod, p.c. to Reynolds, 1985) but which may be as old as late Miocene or as young as middle Pliocene (Gibson, 1971). The Wilson Creek Fault (Matti and others, 1983 and 1985) crosses Yucaipa Ridge and separates the San Gabriel basement from basement rocks typical of the San Bernardino Mountains.

San Bernardino Peak and Mt. San Gorgonio are part of a complex of Precambrian biotite gneiss and schist, and granitoid gneiss intruded by Mesozoic quartz monzonite and granodiorite (Morton and others, 1980b). The massif was glaciated during the Pleistocene (Sharp and others, 1959; Dibblee, 1964).

2.3 (1.9) Holocene alluvium is on both sides of the freeway; to the right at about 2:00, Smiley Heights is on a Pleistocene alluvial surface with a Pleistocene soil (Reynolds and Reeder, 1986). This Pleistocene surface will be encountered repeatedly throughout the Yucaipa/Banning area.

2.6 (0.3) We are driving over terraced Pleistocene sediments near the Orange Street overpass.

3.8 (1.2) At University Street, the freeway crosses the zanja, California State Historical Landmark 43. The first irrigation project in the county, the zanja was constructed in 1819 and 1820 by Serrano and Cahuilla Indians under the guidance of Franciscan fathers from the Mission San Gabriel to develop agriculture at Guachama, the Indian rancheria near the site of the Asistencia mission branch in Old San Bernardino (Redlands) (Quinn, 1980).

4.2 (0.4) Cypress overpass. We are now driving on Pleistocene alluvium (Qoa of Morton, 1978).

4.8 (0.6) Cross the Redlands Fault, a normal fault which elevated Pleistocene alluvium on its southeast side. The trace runs southwest along Crescent Avenue across San Timoteo Canyon to join the San Jacinto fault zone.

5.1 (0.3) Ford Street off ramp. Houses at 10:00 are built on the Pleistocene erosional surface. The degree of soil development suggests the surface is of late but not terminal Pleistocene age.

6.1 (1.0) Reservoir Canyon. Cross the trace of the Crafton Fault (Reservoir Canyon Fault) offsetting Quaternary alluvium and uplifting Precambrian metamorphic and igneous basement rocks (Rogers, 1967). The Crafton Hills are a faulted complex of upper and lower plate rocks divided by the Vincent Thrust. Octavius Decatur Gass located gold-bearing quartz veins on the Yucaipa side of these hills in 1884. By 1889 the "Gold Bar Company" had developed a 60-foot tunnel and in 1890 the water-powered Yucaipa Quartz Mill had been constructed to process gold ore. The mine property was located in the canyon north of Crafton Hills College water tank; the mill site was in Dunlap Acres near 10th Street (Archer, 1976).

6.4 (0.3) Upper plate gneissic quartz diorite exposed in these road cuts, is separated from lower plate Pelona Schist by the Vincent Thrust. On the left, these exposures of the upper plate gneisses include Permo-Triassic Lowe Granodiorite and cataclasites. Pelona Schist is exposed in the road cuts to the left near the top of Reservoir Canyon.

6.8 (0.4) Marked by trees and bushes to the right, Crystal Springs comes to the surface at the fault trace. These springs supported a small bottled water industry in the past. Reservoir Canyon was named from the municipal water reservoir constructed for the Redlands Colony in 1881 (Archer, 1976).

Much of the Yucaipa area was drained through Reservoir Canyon in late Pleistocene times; the drainage was later captured through Live Oak Canyon (Dutcher and Burnham, 1960). Reservoir Canyon was the site of Maria Armenta Bermudez' pioneering farming activities in the area in 1836, when she raised vegetables for the Los Angeles market. Her crops were irrigated by a ditch dug from the zanja near present-day Crafton (Beattie and Beattie, 1951).

7.4 **(0.6)** Continue on Interstate 10 past the Yucaipa Boulevard exit. We are crossing from the upper plate rocks of gneissic quartz diorite into Pleistocene alluvium.

8.1 **(0.7)** Cross the Western Heights Fault, cutting Pleistocene alluvium. This fault, which bounds the Crafton Hills on the southeast, is subparallel to the Redlands Fault.

8.6 **(0.5)** Mount San Jacinto is seen ahead at 12:00; Pisgah Peak (elevation 5,480') is at 10:30. Pisgah Peak is south of the south branch of the San Andreas Fault and consists of upper plate granitic and granitoid gneissic rocks overlying the Vincent Thrust.

9.2 **(0.6)** Cross Live Oak Canyon Holocene alluvium.

9.8 **(0.6)** To the right is deep dissection in the Holocene alluvium overlying eroded Quaternary old alluvium of Live Oak Canyon. The dissection of these recent sediments has occurred since the start of agricultural development in the area, no more than 130 years ago (D. Morton, pers. comm. 1986).

11.2 **(1.4)** At County Line Road off ramp, we have returned to the Pleistocene surface. Fossiliferous Pleistocene sediments of the San Timoteo Formation beneath the Pleistocene surface are located between this off ramp and Calimesa Blvd. off ramp (Dibblee, 1981; Reynolds and Reeder, 1986 and 1991).

12.0 **(0.8)** Calimesa Boulevard off ramp. Continue on I-10.

12.5 **(0.5)** Cross tributary canyon of San Timoteo drainage on flat surface of Holocene alluvium. Here and in the next 0.6 mile, note again the depth of incision that has taken place in little more than 100 years.

14.2 **(1.7)** Terraces to the right are developed on Pleistocene and Holocene alluvium. The badlands topography is developed in the Plio-Pleistocene San Timoteo Formation (Reynolds and Kooser, 1986; Reynolds and Reeder, 1986, 1991). At 10:00 the terraces have been developed at a lower elevation than the badlands topography, and are truncated at their contact with the San Timoteo Formation. The northeast-striking valleys toward the skyline on the left are controlled by a branch of the Mission Creek Fault and the Vincent Thrust. These faults run northeasterly between the south branch of the San Andreas Fault (San Bernardino strand) and the Raywood Flat area on the skyline to the left (Matti and others, 1983).

14.3 **(0.1)** Cherry Valley offramp.

15.0 (0.8) Return to the Pleistocene surface. At 9:00, notice again how the Pleistocene terraces are truncated at the dissected San Timoteo Formation.

16.8 (1.8) The San Timoteo Canyon Road offramp enters San Timoteo Canyon. The freeway leaves the Pleistocene surface and crosses badlands topography and valley fill, regaining the Pleistocene surface near the junction of Highway 60. A terrace inset along San Timoteo Creek is about 200 years old (Reynolds and Kooser, 1986).

17.8 (1.0) CONTINUE on Interstate 10. Offramp to I-60 West is on the right.

18.9 (1.1) Beaumont Avenue/Highway 79 exit. Continue on I-10 East.

19.7 (0.8) San Gorgonio Pass is the lowest topographic break in southern California through the mountains to the inland deserts, separating Mt. San Gorgonio (11,502') and Mr. San Jacinto (10,786'), the two highest mountains in southern California. The crest of the pass, although broad and ill-defined, is the complicated junction of three major drainage basins: the interior-draining Whitewater River-Salton Trough to the east via Smith Creek; the generally interior-draining San Jacinto basin to the south via Potrero Creek; and the Santa Ana basin to the west via San Timoteo Canyon. The junction of these three basins is on the crest of an alluvial fan complex 2.5 miles north of I-10 between Noble Creek on the west and Smith Creek on the east.

We leave the Santa Ana basin and cross eastward to the San Jacinto basin. Through rapid headward erosion, Potrero Creek (to the right at 3:00) has progressed northward, extending the northward limit of the San Jacinto basin along the crest of the alluvial fan complex essentially to Highland Springs, 2.5 miles north of Interstate 10.

20.5 (0.8) At Highland Springs Avenue we leave the San Jacinto basin and cross eastward into the Whitewater River drainage, to the right.

21.0 (0.5) At 10:00, the Banning Bench is bounded on the south by an unnamed thrust fault, and capped by the Heights Fanglomerate of Allen (1957). The deposit is dominated by deeply weathered clasts of gray migmatitic gneiss and greenschist (Pelona Schist) which is probably derived from the upper San Gorgonio River area near the juncture of the Mission Creek and San Bernardino strands of the San Andreas Fault. *Bison* remains have been recovered from the Heights Fanglomerate (Jefferson, 1986) indicating that it is less than 500,000 ybp (Savage and Russell, 1983). The Heights Fanglomerate unconformably overlies sediments similar in appearance to the San Timoteo Formation, which coarsens north of the Banning Fault.

From this point eastward to Whitewater, we enter an area dominated by compressional features.

24.1 (3.1) Pass the exit for Highway 243 to 8th Street and Idyllwild.

26.4 **(2.3)** The houses straight ahead are built on a surface cut by dissected thrust fault scarps (Bortugno and Spittler, 1986; Dibblee, 1982). In the hills to the left, the Banning Fault has thrust basement rocks over non-marine sandstones, siltstones, and conglomerates of the Hathaway Formation. In Lion Canyon, the Hathaway Formation is conformably overlain by the marine Imperial Formation which is in turn conformably overlain by the nonmarine Painted Hill Formation. Elsewhere, the Hathaway Formation is directly overlain by the Painted Hill Formation (Allen, 1957). These three formations, Pliocene in age, are caught up between thrust faults along the base of the mountain front from this point to Stubbe Canyon (Allen, 1957; Dibblee, 1982). Allen (1957) divided the Hathaway Formation into two members, a sandstone-dominated lower member and a conglomerate-dominated upper member distinguished by clasts of laser gneiss derived from an area north of the Banning Fault between Cottonwood and San Gorgonio canyons. He also mentioned rare clasts of silicified limestone without speculating upon their possible source.

The San Gorgonio igneous-metamorphic complex in this area is predominantly migmatitic gneiss with intrusions of quartz monzonite (Morton and others, 1980b).

27.0 **(0.6)** The Cabezon Fanglomerate (lower hills straight ahead) has been anticlinally folded and cut by thrust faults. The Quaternary Cabezon Fanglomerate includes gravels from a variety of sources.

27.6 **(0.6)** To the left, beneath the water tank, is the most youthful thrust fault scarp in this area related to compression associated with activity along the Banning Fault. At this point, the scarp changes orientation from a northwest strike to a northeast strike.

28.3 **(0.7)** To the right at 1:00 is the north portal of the San Jacinto Tunnel, a part of the Colorado River Aqueduct system. It cuts through the Paleozoic? metasediments (quartzofeldspathic gneiss and schist, phyllite, quartzite, and marble) intruded by quartz diorite of Mt. San Jacinto (Morton and others, 1980a).

To the left is Millard Canyon; a fault scarp crosses the alluvial fan near the canyon mouth. The debris of the Millard Canyon fan overwhelms debris from Mt. San Jacinto. Drainage to the base of Mt. San Jacinto is thus forced eastward from this point to the Whitewater River.

28.9 **(0.6)** Cabezon exit. Continue along freeway. To the right, the steep escarpment of the San Jacinto Mountains is interpreted to be the result of uplift on the postulated South Pass Fault (Allen, 1957).

31.2 **(2.3)** Dinosaurs to the north!!

31.5 **(0.3)** Good exposures of the Cabezon Fanglomerate are to the left. Hathaway, Imperial and Painted Hill sediments are thrust over the Cabezon Fanglomerate and are in turn overthrust by the San Gabriel igneous-metamorphic complex. Landslides are common at the noses of the ridges.

To the left at 11:00, Lion Canyon is bounded on the east by a large landslide. The upper "boundary" of this landslide is in the Cabezon Fanglomerate and, as shown by Allen (1957), is convex and points to the south. This is contrary to a landslide headscarp and, because pressure ridges are also apparent within the landslide, suggests that the feature is the result of "bulldozing" by a larger mass to the north and not simply a slope failure.

32.4 **(0.9)** A thrust in the basement rocks to the left at 10:00 at Stubbe Canyon is seen where pink piemontite-bearing rocks are thrust over green epidote-bearing rocks. The distinctive piemontite-bearing gneisses are found as clasts in sediments north and south of the Banning Fault. Since the source area is of limited extent, this has proven useful in estimating fault offset as well as identifying source areas and transport directions (Allen, 1957).

33.2 **(0.8)** The Banning Fault changes from a low angle fault to a steep angle fault (Reynolds and Kooser, 1986).

34.3 **(1.1)** Based on geophysical evidence, the ridge of metamorphic rocks (ahead at 12:00 extending from Mt. San Jacinto) continues beneath the alluvium to a point north of the freeway and northward of the southernmost thrusts characteristic of the San Bernardino Mountains' side of the pass. This ridge reduces the energy of the strong winds which are regularly funneled through San Gorgonio Pass, and dune sands are deposited against it.

35.2 **(0.9)** Whitewater Gravels of the Cabezon Fanglomerate are to the left at 11:00 (Whitewater Hill). The gravels are capped by a Pleistocene soil.

36.0 **(0.8)** Verbenia exit; continue on Interstate 10.

36.7 **(0.7)** Highway 111 to Palm Springs passes through the old Whitewater Ranch property. Do not exit. Landslide deposits are to the left.

37.0 **(0.3)** To the left, the Garnet Hill Fault disrupts alluvium 2/3 of the way from the freeway to the base of the hills. The fault runs across the mouth of Whitewater Canyon where it is visible at 9:00. The fault trace is exposed only west of Whitewater River. Based on trenching between Cottonwood and Whitewater Canyons, there is no evidence for Holocene activity on the Garnet Hill Fault (Reeder, p.c. 1986, cited in Reynolds and Kooser, 1986). The Garnet Hill Fault displaces Pleistocene-age Whitewater gravels of Windmill Hill (Allen, 1957). To the east, its trace is covered by alluvium and the main evidence for its existence within the Coachella Valley is a strong gravity anomaly. Gravity low contours define a trough which is almost as well delineated as the gravity troughs associated with the Banning and Mission Creek faults (Proctor, 1968). Proctor suggests that the Garnet Hill Fault may be an ancestral branch of the San Andreas Fault.

37.6 **(0.6)** South of the Interstate, large cottonwood trees and scant building ruins mark the site of the Whitewater Ranch headquarters. Pauline Weaver and Isaac Williams were the first Anglos to own land in the San Gorgonio Pass; their San Gorgonio Rancho was granted in 1845 and encompassed the entire pass area. Weaver sold a portion of the rancho to Isaac Smith in 1853; this purchase, which included the land from Beaumont to Palm Springs, was to develop into the Whitewater Ranch. The riparian water rights from the Whitewater River granted in 1850 passed with the ranch to successive owners and allowed ranching to continue. The site was also a regular freight and stage stop along the Butterfield route (Stocker, 1973).

37.8 **(0.2)** Rest area at Whitewater Ranch site.

38.5 **(0.7)** Whitewater Road exit; continue on I-10.

39.0 **(0.5)** Beneath the three buildings at 11:00 (left) is the reverse fault scarp of the Garnet Hill Fault.

39.3 **(0.3)** Cross the Whitewater River.

39.8 **(0.5)** The north side of the freeway runs along the trace of the Garnet Hill Fault next to Whitewater Hill. To the left are Pleistocene fan sediments of the Cabezon Fanglomerate separated from the Imperial and Painted Hill formations (Murphy, 1986) by the Banning Fault. The Cabezon Fanglomerate of Whitewater Hill includes a lens of limestone breccia believed to have been derived from the San Jacinto block (Allen, 1957). Proctor (1968) notes that Whitewater Hill has been uplifted so recently that relict drainages exposed on its surface do not conform to its current topography.

Move to the right lane and prepare to exit.

40.7 **(0.9)** EXIT RIGHT on the Yucca Valley—29 Palms offramp, following Highway 62 northward over the freeway.

41.1 **(0.4)** View southeast down the axis of the Salton Trough. The Garnet Hill Fault trace is on the south side of the low hills (Garnet Hill).

42.2 **(1.1)** Dillon Road. Red exposures at the Whitewater Rock Quarry are visible to the left at 9:00.

42.6 **(0.8)** To the right at 1:00, the trace of the Banning Fault is expressed as shutter ridges between the powerline and windmills. Devers Hill protrudes through the alluvium to the right.

42.9 **(0.3)** Cross the Banning Fault over the next 0.1 mile.

44.8 **(1.9)** Pierson Blvd. Mt. San Gorgonio is viewed to the left at 10:00; to the right at 2:00 are the Little San Bernardino Mountains.

46.4 **(1.6)** Mission Creek Road crosses Highway 62. To the left are dissected Mission Creek alluvial deposits cut by northeast-striking faults with the east side down. To the right at 2:00 is a fault-bounded prism of pinkish sediments against the mountain front which is bounded by the Mission Creek strand of the San Andreas fault system.

47.1 **(0.7)** Cross Mission Creek Wash for the next 0.3 miles.

47.9 **(0.8)** Indian Avenue; continue on Highway 62.

48.1 **(0.2)** Cross the Mission Creek Fault of the San Andreas fault system as you head up Dry Morongo Canyon, entering Mesozoic deformed pluton and Precambrian gneiss. We are leaving the segment of the field trip that is controlled by the right lateral San Andreas fault system and entering the segment of the trip that is influenced by the left lateral Pinto Mountain fault system.

Pinto Mountain Fault Segment

A portion of the Transverse Range Province lies north of the San Andreas fault system and south of the left lateral Pinto Mountain Fault. The Pinto Mountain Fault is a major left-lateral fault which represents the southern structural boundary of the Mojave block (Dibblee, 1992). The Mojave Desert is characterized by a series of active northwest-trending right lateral faults. These faults apparently terminate at or are truncated by the Pinto Mountain Fault. We will be traveling parallel to the left lateral Pinto Mountain Fault until we reach Twentynine Palms.

50.4 **(2.3)** Cross the trace of the Morongo Valley Fault, trending northeast towards Morongo Summit, where it intersects with the Pinto Mountain Fault.

50.7 **(0.3)** To the left is perched alluvium.

51.0 **(0.3)** The highway enters fault-bounded Morongo Valley, with the Pinto Mountain Fault on the north side of the valley and the Morongo Valley Fault on the south side. Morongo Valley drains southward into the Whitewater drainage, which runs through the Coachella Valley and into the Salton Sea.

52.2 **(1.2)** Covington Park and the Big Morongo Wildlife Refuge are to the right via East Drive. The nature reserve is a habitat for more than 240 species of resident and migrant birds as well as a sanctuary for mammals including big horn sheep. Permanent water, brought to the surface at springs along the Morongo Valley Fault, supports a lush riparian community. Continue on Highway 62.

52.7 **(0.4)** A landfill is to the right at 2:00. Note that ridges are terminated by the *en echelon* Morongo Valley Fault east of Big Morongo Canyon. The terrace at the east end of the landfill is capped by a well-developed red soil horizon.

54.0 **(1.3)** The Pinto Mountain Fault runs on the north side of the valley north of the highway. As you look ahead toward the pass, you see the intersection of the Pinto Mountain Fault and the Morongo Valley Fault.

56.3 **(2.3)** Pass Ole Street.

56.5 **(0.2)** Light gray granitic bedrock to the left is separated from overlying brownish granitic bedrock by low angle faults and shears. Note the vegetation growth along the fault contacts. North, at 9:00, the Pinto Mountain Fault crosses near the house (at 11:00) and water tank.

57.0 **(0.5)** Pass Highland Street.