Faults in Antelope Valley, Slinkard Valley, and along the West Walker River, Mono County

by

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INTRODUCTION

Potentially active faults located in northern Mono County near the community of Coleville include the Antelope Valley fault, "Larson Lane" fault, East Antelope Valley fault zone, and the Slinkard Valley fault (figure 1). The fault zone near the intersection of Highways 395 and 108 (Sonora Junction) is termed the West Walker River fault zone (figure 1). These faults are evaluated as part of a statewide effort to evaluate faults for recency of movement. Those faults determined to be sufficiently active and well defined are zoned by the State Geologist as directed by the Alquist-Priolo Special Studies Zones Act (Hart, 1980).

REVIEW OF AVAILABLE DATA

The Antelope Valley-Sonora Junction FER study area is characterized by Basin and Range style normal faulting. Topography in the FER study area ranges from the relatively flat to gently sloping floor of Antelope Valley to the precipitous slopes of the Sierra Nevada bordering the west side of Antelope Valley and Slinkard Valley.

Predominant rock types encountered in the FER study area include pre-Cretaceous metamorphic rocks, Cretaceous granitic rocks, Tertiary volcanic rocks, and extensive late Pleistocene glacial deposits in the Sonora Junction area (Stewart, et al., 1982; John, et al., 1981; Halsey, 1953; Curtis, 1951; Koenig, 1963; Clark, 1967). Surficial deposits in Antelope Valley include late Pleistocene older alluvium, late Pleistocene to Holocene alluvium and terrace deposits of the West Walker River, and Holocene alluvial fan deposits and flood plain deposits of the West Walker River (Dohrenwend, 1982; John, et al., 1981).

Development is sparse in the FER study area and is generally limited to Highway 395, particularly near the small towns of Coleville and Walker. Highway 395 locally obscures the Antelope Valley fault in the vicinity of Topaz Lake. Agricultural land use and irrigation canals also locally obscure or have destroyed geomorphic evidence of recent faulting along the Antelope Valley fault. However, land surfaces generally remain unaltered by man in the FER study area.

Antelope Valley Fault

The Antelope Valley fault is a north to north-northwest-trending normal fault with down-to-the-east displacement. The fault forms the western boundary of Antelope Valley, a down-dropped block or graben. Halsey (1953) estimates that between 2,000 to 4,000 feet of cumulative down-to-the-east displacement has occurred along the Antelope Valley fault. The upthrown block, or hanging wall, has been rotated to the west and is, in turn, bounded by the Slinkard Valley fault on the west.

Both Curtis (1951) and Halsey (1953) map faults along the west side of Antelope Valley that offset Quaternary alluvium. However, the fault traces are generalized and will not be evaluated in this FER.

John, et al. (1981) map a zone of discontinuous faults along the west side of Antelope Valley (figure 2a). Pleistocene pediment deposits are offset against Holocene deposits at the very eastern border of the Topaz Lake quadrangle. Holocene alluvial fans are mapped as offset against Cretaceous granitic and pre-Cretaceous metamorphic rocks in Sections 18, 7, 12, and 1, T8N, R22E, and Sections 36, 26, 14, and 11, T9N, R22E (figure 2a). From about Section 2, T9N, R22E north, John, et al. map the Antelope Valley fault as concealed by alluvium (figure 2a).

Dohrenwend (1982a,b) compiled Quaternary geologic mapping on the 1:250,000 scale Walker Lake sheet. Dohrenwend (1982b) considers the Antelope Valley fault to be a major range-front fault. Fault traces in the Topaz Lake quadrangle mapped by Dohrenwend essentially are the same as those mapped by John, et al. (1981). A prominent east-facing scarp characterizes the Antelope Valley fault in the Desert Creek Peak quadrangle (figure 2b). Dohrenwend (1982a) indicates that Pleistocene pediment deposits and bedrock are offset against late Pleistocene and Holocene alluvium along the Antelope Valley fault. Farther south near the mouth of Mill Canyon, Dohrenwend maps the Antelope Valley fault as concealed by late Pleistocene to Holocene alluvium.

Clark (1967, 1972) maps the southern segment of the Antelope Valley fault that corresponds well with Dohrenwend (1982) (figures 2a, 2b). However, Clark maps the fault as inferred.

Envicom (1976) mapped segments of the Antelope Valley fault in the southern portion of the Topaz Lake quadrangle and the Desert Creek Peak quadrangle (figures 2a, 2b). Fault traces mapped by Envicom in the Desert Creek Peak quadrangle generally coincide with the faults mapped by Dohrenwend (1982) and Clark (1967, 1972). Differences in location between Envicom (1976) and John, et al. (1981) occur in the Topaz Lake quadrangle in the vicinity of Coleville. Envicom considers the Antelope Valley fault to be "potentially active", based on the offset Pleistocene alluvium in Section 18, T8N, R23E (Pleistocene pediment deposits of John, et al., 1981, and Dohrenwend, 1982) (figures 2a, 2b).

Little Antelope Valley, located west of Walker, may have been at one time part of Antelope Valley, based on the pediment deposits mapped by Dohrenwend (1982a) and John, et al. (1981). Several faults have been mapped in Little Antelope Valley and are considered in this FER to be segments of the Antelope Valley fault.

Curtis (1951) maps an inferred fault along the northern boundary of Little Antelope Valley and along the west side of the valley. These faults are very generalized and will not be evaluated in this FER. Halsey (1953) maps faults along the borders of Little Antelope Valley, but does not indicate whether or not he considers these faults to be recently active.

John, et al. (1981) and Dohrenwend (1982a,b) map faults along the western and northern sides of Little Antelope Valley (figure 2a). They also map a north-trending fault in alluvium near the eastern edge of the Topaz Lake quadrangle. The north-trending fault along the western margin of Little Antelope Valley offsets Pleistocene alluvial fan deposits against late Pleistocene to Holcene alluvium in Section 23, T8N, R22E (figures 2a). The sense of displacement is normal, down to the east. The fault changes to a northeast trend in Section 14, T8N, R22E and offsets older alluvial fan deposits against younger fan deposits (figure 2a). An east northeast-trending fault at the southern end of Centennial Bluff juxtaposes Jurassic metarhyolite against Pleistocene pediment deposits. To the east, a north-trending fault offsets late Pleistocene to Holocene alluvium in Section 24 and bedrock against Holocene alluvium in Sections 25 and 36 (Dohrenwend, 1982a; John, et al. 1981) (figure 2a).

Clark (1972) maps discontinuous, east-facing scarps in older alluvium that are similar in trend and location to faults mapped by Dohrenwend (1982) and John, et al. (1981) (figure 2b).

Evicom (1976) mapped several north to northwest-trending faults in alluvium along the east side of Little Antelope Valley (figures 2a, 2b). These faults are shown to form a graben, but are mapped as only approximately located.

"Larson Lane" Fault

A north-trending fault mapped by Dohrenwend (1982a,b) is located south of Larson Lane and will be informally referred to as the "Larson Lane" fault (figure 2b). The Larson Lane fault is a normal fault with down-to-the-east displacement. It juxtaposes older Pleistocene alluvial fan deposits on the west against younger (late Pleistocene to Holocene) alluvial deposits on the east. Although no previous workers have identified this fault, Dohrenwend mapped it as a well-defined feature.

East Antelope Valley Fault Zone

A complex zone of normal faults characterized by both east and west-facing scarps are mapped on the east side of Antelope Valley by Halsey (1953), Clark (1972), and Dohrenwend (1982a,b) (figure 2b).

Halsey (1953) mapped a north-trending zone of faults along the east side of Antelope Valley. The principal fault traces are generalized and will not be evaluated in this FER.

Clark (1972) mapped a broadly arcuate, north to northwest-trending fault in the southeastern part of Antelope Valley near Camp Antelope (figure 2b). The fault juxtaposes bedrock against Pleistocene and Holocene(?) alluvium, but Clark mapped the fault as inferred. Another inferred fault between bedrock and alluvium was mapped by Clark (1972) west of West Walker River (figure 2b). No evidence of these inferred faults was observed on the aerial photos (figure 2b).

Dohrenwend (1982a,b) mapped a complex zone of essentially north-trending faults along the east side of Antelope Valley (figure 2b). Pleistocene and late Pleistocene to Holocene alluvial fan deposits are offset along the East Antelope Valley fault zone as mapped by Dohrenwend (1982a) (figure 2b). North of the study area Dohrenwend (1982a) mapped a Holocene alluvial fan as offset by a segment of the East Antelope Valley fault zone (figure 2b).

Envicom (1976) evaluated faults along the east side of Antelope Valley and concluded that the "existence of at least some of them (faults) is questionable, and those rock boundaries that probably are faults appear to be sufficiently ancient as to constitute only a very low hazard of future surface rupture."

Slinkard Valley Fault

Halsey (1953) and Curtis (1951) mapped a north-northwest-trending fault along the west side of Slinkard Valley. The Slinkard Valley fault is normal with down-to-the-east displacement. The downthrown block is tilted to the west and is the upthrown block of the Antelope Valley fault. Several thousand feet of late-Cenozoic down-to-the-east displacement has occurred along the Slinkard Valley fault (Halsey, 1953). Curtis (1951) mapped alluvium as offset along the Slinkard Valley fault where the valley forms reentrants into the range front. However, faults mapped by both Curtis (1951) and Halsey (1953) are too generalized to be critically evaluated in this FER.

John, et al. (1981) and Dohrenwend (1982a,b) mapped a zone of discontinuous normal faults along the west side of Slinkard Valley (figure 2a). Mainly, these faults juxtapose bedrock against late Pleistocene to Holocene alluvium. John, et al. mapped the faults as concealed where they extend into Holocene alluvium (figure 2a). The southernmost segment of the Slinkard Valley fault mapped by John, et al. (1981) cuts late Pleistocene to Holocene alluvium in Section 22, T8N, R22E (figure 2a). However, Dohrenwend (1982a) mapped this fault as concealed by late Pleistocene to Holocene alluvium. The northern end of the Slinkard Valley fault is concealed by a large landslide (John, et al., 1981) (figure 2a).

West Walker River Fault Zone

Halsey (1953) mapped a north-trending fault that apparently controls the course of the West Walker River. Near Sonora Junction, Halsey states that faults offset Sherwin-age moraines near Burcham Flat, but Tahoe and Tioga moraines generally are not offset.

Clark (1967, 1972, 1975) mapped a zone of discontinuous north to northeast-trending faults near the West Walker River (figure 2c). The southernmost of these faults offset Tioga-stage (13,000 to 20,000 yrs. BP) morainal deposits near the vicinity of Sonora Junction (Sections 32 and 20, T6N, R23E) (figure 2c). Sense of offset along these faults is normal, down to the east. Faults with down-to-the-east normal displacement offset glacial deposits of probable Sherwin-age (greater than 700,000 yr. BP) in the Burcham Flat area. Clark maps a graben structure in Section 34, T7N, R23E, although he indicates that these faults, and northeast-trending faults farther to the north, are not well defined (figure 2c).

INTERPRETATION OF AERIAL PHOTOGRAPHS

Air photo interpretation by this writer of faults in the FER study area was accomplished using U.S. Bureau of Land Management color air photos (CA01-77, 1977, scale 1:24,000). Air photo interpretation of the West Walker River fault zone was accomplished using U.S. Department of Agriculture (CNL, 1940) air photos at a scale of 1:20,000, U.S. Forest Service air photos (EME, 1963) at a scale of 1:15,840, and U.S. Geological Survey air photos (WR, 1967) at a scale of 1:20,000.

Antelope Valley Fault

Results of air photo interpretation by this writer along the Antelope Valley fault are summarized on figure 3. The Antelope Valley fault is characterized by well-defined scarps and breaks in slope at the base of a prominent east-facing escarpment that is approximately 2,200 feet high. The Antelope Valley fault is generally well defined from near the settlement of Walker northwest to the northern part of Section 12, T8N, R22E (figure 3). Traces mapped by John, et al. (1981), Dohrenwend (1982a,b), Clark (1972), and locally by Envicom (1976) along this segment of the Antelope Valley fault generally correspond with the faults mapped by this writer. Geomorphic evidence of Holocene activity is indicated by vertically offset alluvial fan surfaces and possible vertically offset drainages (figure 3).

Fault segments characterized by geomorphic features indicating recency were observed by this writer only in the western portion of Little Antelope Valley (Sections 14 and 23, T8N, R22E, figure 3). Moderately well-defined, east-facing scarps juxtapose Pleistocene alluvium on the west against late Pleistocene to Holocene alluvium on the east (John, et al. 1981; Dohrenwend, 1982a). Faults in the eastern part of Little Antelope Valley mapped by John, et al. (1981), Dohrenwend (1982a,b), and Envicom (1976) are not well-defined and could not be verified by this writer (figures 2a, 2b).

North of Section 12, T8N, R22E, traces of the Antelope Valley fault are more discontinuous. Well-defined traces were observed by this writer in Section 1, T8N, R22E, and Sections 26, 23, 14, and 11, T9N, R22E (figure 3). Geomorphic evidence indicating Holocene activity includes vertically offset alluvial fan surfaces, linear vegetation contrasts in Holocene alluvium, oversteepened talus cones, and vertically offset drainages. The Antelope Valley fault generally is not well defined north of Highway 89 (figures 2a, 3), where it may be partly concealed under late(?) Holocene fan and lake deposits. Grading for Highway 395 obscures any specific geomorphic evidence of Holocene faulting, although the relatively steep slopes suggest recent faulting. Also, Topaz Lake is a large closed depression, which further suggests recent displacement along the northern segment of the Antelope Valley fault.

"Larson Lane" fault

The Larson Lane fault is a well-defined normal fault characterized by a north-trending, east-facing scarp between Pleistocene alluvium on the west and late Pleistocene to Holocene alluvium on the east (figure 3). Slight differences in location exist between the fault traces mapped by Dohrenwend (1982a,b) and this writer, no doubt because Dohrenwend's traces were transferred from a 1:250,000 base map. No geomorphic evidence of faulting was observed by this writer north of Larson Lane.

Just north of the West Walker River, the Larson Lane fault steps left and vertically offsets (down to the east) a late Pleistocene to Holocene river terrace (figure 3). This east-facing scarp has been modified to some extent by an irrigation canal. A tonal lineament and a low, east-facing scarp in Holocene flood plain deposits of the Walker River indicates that offset along this fault has occurred during Holocene time.

East Antelope Valley Fault Zone

The East Antelope Valley fault zone mapped by Dohrenwend (1982a,b) generally is not well-defined, based on air photo interpretation by this writer (figures 2b, 3). Scarps in older alluvium were observed by this writer in Sections 4, 9, and 21, T8N, R23E, but geomorphic evidence of Holocene offset was not observed along the East Antelope Valley fault zone. This writer was unable to verify Dohrenwend's (1982a) faulted Holocene alluvium north of the study area in Section 19, T9N, R23E (figure 2b). Faults east of the principal fault bordering the eastern Antelope Valley were not evaluated in this FER, based on the relative remoteness of the faults and the limited time available for this study (figures 1, 2b).

Slinkard Valley Fault

Fault segments bordering the western side of Slinkard Valley generally are not as well defined as fault segments bordering the western side of Antelope Valley (figure 3). An east-facing scarp in Section 9, T8N, R22E offsets bedrock against late Pleistocene to Holocene alluvium mapped by John et al. (1981), but the scarp is eroded (figure 3). A tonal lineament (possible east-facing scarp) in a talus slope is located in Section 32, T9N, R22E and is the only feature observed by this writer along the Slinkard Valley fault that suggests possible Holocene activity (figure 3).

West Walker River Fault Zone

Air photo interpretation by this writer was limited to verifying and annotating the faults mapped by Clark (1967, 1972) (figure 2c). The southernmost fault mapped by Clark (1967, 1972) (Section 32, T6N, R23E) is characterized by a very well-defined, though somewhat discontinuous, east-facing scarp in Tioga morainal deposits (figure 2c). Geomorphic evidence of Holocene activity along this fault segment includes an undissected fault scarp, vertically offset drainages, and a trough along the base of the scarp (figure 2c). Discontinuous scarps in alluvium near Junction Reservoir are well defined, as is the northeast-trending fault just south of Highway 108 (figure 2c). Faults mapped by Clark northeast and east of the West Walker River generally are not well defined and are not characterized by geomorphic evidence of Holocene activity (figure 2c). A possible exception is the west-facing scarp north of Burcham Flat (Section 3, T6N, R23E). A well-defined scarp (in Sherwin-age deposits) and a possible vertically offset drainage indicate Pleistocene activity and possibly Holocene activity.

FIELD OBSERVATIONS

Two and one-half days were spent in the Antelope Valley/Sonora Junction area during the month of August 1983 by this writer in order to verify selected faults interpreted from air photos. An additional day in the field in September 1983 was spent with E.W. Hart. Subtle features not observable on the photos were mapped in the field. In addition, ages of lithologic units and offset geomorphic surfaces were estimated based on degree of soil development and degree of dissection.

An attempt was made to measure fault scarp profiles in order to estimate recency of faulting based on the work of Wallace (1977). Points of observation and locations where fault scarp profiles were measured are shown on figures 2c and 3 and are summarized in Table 1. It should be emphasized that these measurements represent only approximations of scarp height, angle, and width of scarp crest. Scarp height was measured using the method described by Lahee (1961, p. 454). Scarp angle was estimated by using a Brunton compass clinometer and an improvised leveling rod, as described by Wallace (1977). The width of the scarp's crest was estimated by pacing.

A direct correlation between the ages indicated by fault-scarp profiles measured by Wallace (1977) in Nevada and scarp profiles measured during investigations for this FER cannot be made due to different lithology, climate, and styles of faulting (Mayer, 1982). However, the data presented by Wallace (1977, 1978) can be used as a guide (or additional factor) when evaluating the geomorphic features and age of offset deposits (when known) for recency of faulting. Some very general guidelines for estimating scarp ages are summarized as follows: minimum slope angles for fault scarps in unconsolidated alluvium and colluvium no older than 10,000 to 12,000 yrs. BP can range from 10^{o} to 20^{o} (Wallace, 1977). The average scarp angle is about 14^{o} to 15^{o}, based on figure 8 of Wallace (1977), although figure 12 of Wallace (1977) indicates that scarp angles of about 19^{o} represent minimum Holocene age. The scarp crest width for scarps no older than about 10,000 yrs BP ranges from 3.2 to about 16 feet (figure 11 from Wallace, 1977). Wide variations occur, but these figures probably represent minimum (i.e. conservative) criteria suggesting Holocene ages. The Antelope Valley/West Walker River study area is wetter than Wallace's Nevada study region and is probably subject to more rapid degradation of the geomorphic features.

Antelope Valley Fault

The Antelope Valley fault is generally well defined, although somewhat discontinuous. Geomorphic evidence observed along the fault suggesting recent activity (uplift) is characterized by precipitous east-facing slopes with typical "wine-glass" drainages across the fault. Well-defined, east-facing scarps delineate vertically offset alluvial fan surfaces along many of the drainages that cross the Antelope Valley fault (figure 3). The heights of these fault scarps range from 13 feet to 20 feet, with scarp angles from 23^{o} to 32^{o}. The fan surfaces are relatively undissected and are probably quite youthful. North of Centennial Bluff, an artificial exposure across a faulted alluvial fan revealed a series of buried A soil horizons (figure 3). No evidence of B horizon development was observed, strongly indicating that the alluvial fan surface is very young (probably Holocene). Soil development is similar on both the upthrown and downthrown surfaces of the alluvial fan in the NE 1/4 Section 12, T8N, R22E, indicating that the surfaces are offset and that the east-facing scarp is due to faulting rather than erosion (figure 3). Youthful, very steep (approx. 40^{o}) talus cones issuing from the steep east-facing slope of Centennial Bluff further imply very recent uplift.

An arcuate (convex toward the east) inferred fault trace was observed just east of the main scarp in Section 18, T8N, R23E (figure 3). This feature, delineated by a five-foot high east-facing scarp, has been modified by grading for an irrigation canal and may be totally artificial. However, it is possible that this scarp represents the most recent offset along the southern segment of the Antelope Valley fault. The main drainage crossing this feature has incised into its channel, forming a constructional terrace. The alluvial terrace at the north of the channel seems natural, is logically associated with the fill terrace upstream, and is partly dissected at the scarp crest. These features suggest that the scarp and alluvial terrace are natural and thus were probably formed either by recent faulting or, perhaps, by lateral stream erosion.

A major fault zone exposed in granitic bedrock was observed along Highway 89 just west of its intersection with Highway 395 (figure 3). A prominent shear fabric in bedrock generally coincides with the geomorphic features indicating recent faulting at this location. The shear zone is at least 300' to 400' wide, and down-to-the-east displacements of small dikes are consistent with the sense of displacement along the Antelope Valley fault. Soil-filled fissures in bedrock were observed near the principal active fault trace, suggesting recent downhill movement.

Hot water wells are located in the southernmost part of Section 18, T8N, R23E (figure 3). The presence of the hot water indicates that bedrock faulting occurs beneath the alluvium along the Antelope Valley escarpment.

The fault along the west side of Little Antelope Valley is locally well defined, but this north to northeast-trending fault is discontinuous (figure 3). Scarp angles measured along this east-facing fault scarp range from 14° to 20°, suggesting Holocene activity.

"Larson Lane" Fault

The north-trending Larson Lane fault is well defined and is characterized by scarp angles ranging from 18° to 21° in unconsolidated older alluvium, with scarp crest widths ranging from 4 feet to 6 feet (figure 3). However, stream erosion has enhanced the scarp profile. The upthrown block, or hanging wall, of the Larson Lane fault seems to be tilted to the west. Because the alluvial fan surfaces naturally slope to the west and because of tectonic tilting westward toward the Antelope Valley fault, it is difficult to ascertain whether or not the westerly slope has been "tectonically enhanced." The Larson Lane fault may actually be an abandoned channel of the West Walker River that locally has been enhanced by stream erosion. Evidence supporting the erosional origin of this feature includes the general northward flow of the modern West Walker River, and the somewhat scalloped nature of the east-facing scarp. However, the west side of this feature is higher than the east side, strongly indicating that differential uplift has occurred. The older alluvial surface has been displaced by the Larson Lane fault.

East Antelope Valley Fault Zone

Geomorphic evidence of Holocene-active faults along the East Antelope Valley fault zone was not observed by this writer. An east-facing fault scarp in older alluvium, observed in Section 9, T8N, R23E (figure 3), is characterized by a scarp angle of 10°, scarp height of 6 feet to 7 feet, and a crest width of greater than 20 feet. A west-facing scarp located in Sections 33 and 28, T9N, R23E is associated with what seems to be recent vertically offset drainages, based on air photo interpretation by this writer (figure 3). However, field checking indicates that constriction of the mouths of the drainages is due to steeply west-dipping beds of resistant meta-limestone.

Slinkard Valley Fault

This writer was unable to field check segments of the Slinkard Valley fault in August due to a lack of access (locked gates) and a shortage of time.

West Walker River Fault Zone

Selected segments of the West Walker River fault zone south of Highway 108 were field checked. The east-facing scarp in Section 32, T6N, R23E is very well defined and is characterized by scarp angles ranging from 32° to 35° and crest widths of 2 feet to 4 feet (figure 2c). Vertically offset drainages and a trough, or linear depression, at the base of the scarp strongly indicate Holocene activity. The northeast-trending fault just south of Highway 108 offsets Tioga morainal debris (Clark, 1975) and is very well defined (figure 3). Scarp angles ranging from 32° to 35° in unconsolidated till, a vertically offset drainage, and a possible east-facing scarplet in Holocene alluvium strongly indicate Holocene activity.

SEISMICITY

Seismicity in the FER study area is depicted in figure 4 (Real, et al., 1978). An association of earthquake epicenters with specific fault traces is not apparent. An earthquake in the M5.0-M5.9 range occurred just east of the Antelope Valley fault, as did an earthquake in the M4.0-M4.9 range (figure 4). A few additional epicenters are located in Antelope Valley. No seismicity has occurred in the Sonora Junction area (figure 3). It should be pointed out that the quality of epicenters ranges from A through D; thus, any assumptions regarding earthquake activity along specific fault traces is somewhat speculative.

CONCLUSIONS

Antelope Valley Fault

The Antelope Valley fault is a normal fault with cumulative down-to-the-east displacement from 2,000 feet to 4,000 feet (Halsey, 1953). The north to northwest-trending fault is somewhat discontinuous at the surface, but is locally well defined. Geomorphic evidence suggesting Holocene activity is characterized by precipitous east-facing slopes with typical "wine-glass" drainages developed across the fault. Specific geomorphic evidence strongly indicating Holocene activity observed by this writer includes offset Holocene alluvial fan surfaces and very steep talus cones that steepen across the trend of the fault (figure 3). Holocene activity along the Antelope Valley fault is suggested by fault scarp profiles across scarps in alluvial fans of probable Holocene age (figure 3, Table 1). Faults mapped by John, et al. (1981), Envicom (1976), and Clark (1972), and this writer agree in general, although differences in detail exist.

The Antelope Valley fault is obscured by very young alluvium and by the construction of Highway 395, north of Highway 89, although the extremely steep east-facing slope and the presence of Topaz Lake (a large depression) suggest recent fault activity close to the highway.

Faults in Little Antelope Valley mapped by John, et al. (1981), Dohrenwend (1982a,b), and Envicom (1976) generally are not well defined (figures 2a, 2b). East-facing scarps in late Pleistocene to Holocene alluvium mapped by Clark (1972) (which partly correspond to fault segments mapped by John, et al., 1981) were locally verified by this writer (figure 3). These fault segments are discontinuous, relatively short, and are characterized by geomorphic evidence suggestive of Holocene activity (figure 3).

"Larson Lane" Fault

The Larson Lane fault, first mapped by Dohrenwend (1982a,b), is characterized by an east-facing scarp in Pleistocene alluvium (figure 2b). To the north of Larson Lane, Dohrenwend mapped late Pleistocene to Holocene alluvium as offset by the fault. However, this writer was unable to verify a fault north of Larson Lane (figure 3). The Larson Lane fault is characterized by a relatively well-defined east-facing scarp that has been enhanced by stream erosion near its southern end. Near its southern end, the fault steps left and vertically offsets a late Pleistocene to Holocene river terrace (figure 3). A subtle, east-facing scarp and associated tonal lineaments in late(?) Holocene floodplain deposits indicate Holocene activity.

East Antelope Valley Fault Zone

The East Antelope Valley fault zone is generally not well defined (figures 2b, 3). Discontinuous, subtle scarps in older alluvial fan deposits were mapped by Dohrenwend (1982a) and verified by this writer. However, geomorphic evidence of Holocene-active faults was not observed by this writer.

Slinkard Valley Fault

The Slinkard Valley fault mapped by John, et al. (1981) is generally not well defined. John, et al. map late Pleistocene to Holocene alluvium as locally offset, but clear geomorphic evidence of Holocene activity was not observed by this writer (figure 3).

West Walker River Fault Zone

The West Walker River fault zone, mapped by Clark (1967, 1972, 1975), is characterized by a zone of discontinuous north to northeast-trending normal faults. North of the Burcham Flat area, the fault zone generally is not well defined. To the south of Burcham Flat, the fault zone is well defined, although it is somewhat discontinuous. The fault zone southwest of Highway 108 is characterized by down-to-the-east normal faults in Tioga morainal deposits and alluvium of probable Holocene age (Clark, 1975). The fault locally is very well defined and is characterized by vertically offset drainages, offset crests of Tioga moraine (Clark, 1975), and a trough along the base of the scarp (figure 2c). Fault scarp profiles measured across segments of the West Walker River fault zone support Holocene activity (figure 2c, Table 1).

RECOMMENDATIONS

Recommendations for zoning faults for special studies are based on the criteria of "sufficiently active" and "well-defined" (Hart, 1980).

Antelope Valley Fault

Zone for special studies well-defined faults shown on figures 5a and 5b. Principal references cited should be John, et al. (1981), Dohrenwend (1982), and this FER.

"Larson Lane" Fault

Zone for special studies well-defined faults shown on figure 5b. Principal references cited should be Dohrenwend (1982) and this FER.

East Antelope Valley Fault Zone

Do not zone for special studies traces of the East Antelope Valley fault zone.

Slinkard Valley Fault

Do not zone for special studies traces of the Slinkard Valley fault.

West Walker River Fault Zone

Zone for special studies well-defined faults shown on figure 5c. Principal references cited should be Clark (1972) and this FER.

I concur with the recommendations. Earl W. Hart CEG 935 3/15/84

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TABLE 1 (to FER-154) - Fault Scarp Profiles

Fault Name/Location	Height	Angle	Crest Width	Material Offset	Fault Type[1]
Sonora Junction area Sec.32,T6N,R23E	20'	35°	3'-4'	latest Pleistocene to Holocene Tioga moraine	nf
Sonora Junction area Sec.32,T6N,R23E (same fault)	18'-19'	32°	2'	Tioga moraine	nf
Little Antelope Valley Sec.23,T8N,R22E	13-1/2'	14°	10'-15'	Pleistocene older alluvial fan material	nf
Little Antelope Valley Sec.14,T8N,R22E	26'	20°	15'	older alluvium against younger alluvium	nf
Antelope Valley fault Sec.12,T8N,R22E	15'	32°	4'-5'	Holocene( )alluvial fan	nf
Antelope Valley fault Sec. 1,T8N,R22E	13'-14'	23°	5'-6'	Holocene( )alluvial fan	nf
Antelope Valley fault Sec.26,T9N,R22E	20'	30°-32°	6'	Holocene( )alluvial fan	nf
"Larson Lane" fault Sec.20,T8N,R23E	12'	21°	4'-5'	Pleistocene alluvium against Holocene alluvium	nf
"Larson Lane" fault Sec.20,T8N,R23E (same fault)	13'	18°-20°	5'-6'	Pleistocene alluvium against Holocene alluvium	nf
E. Antelope Valley Sec.9,T8N,R23E	6'-7'	10°	15'-20'	older alluvium(Pleistocene)	bfs

1 bfs = back-facing scarp (mountain-side down); nf = normal fault scarp (valley-side down).

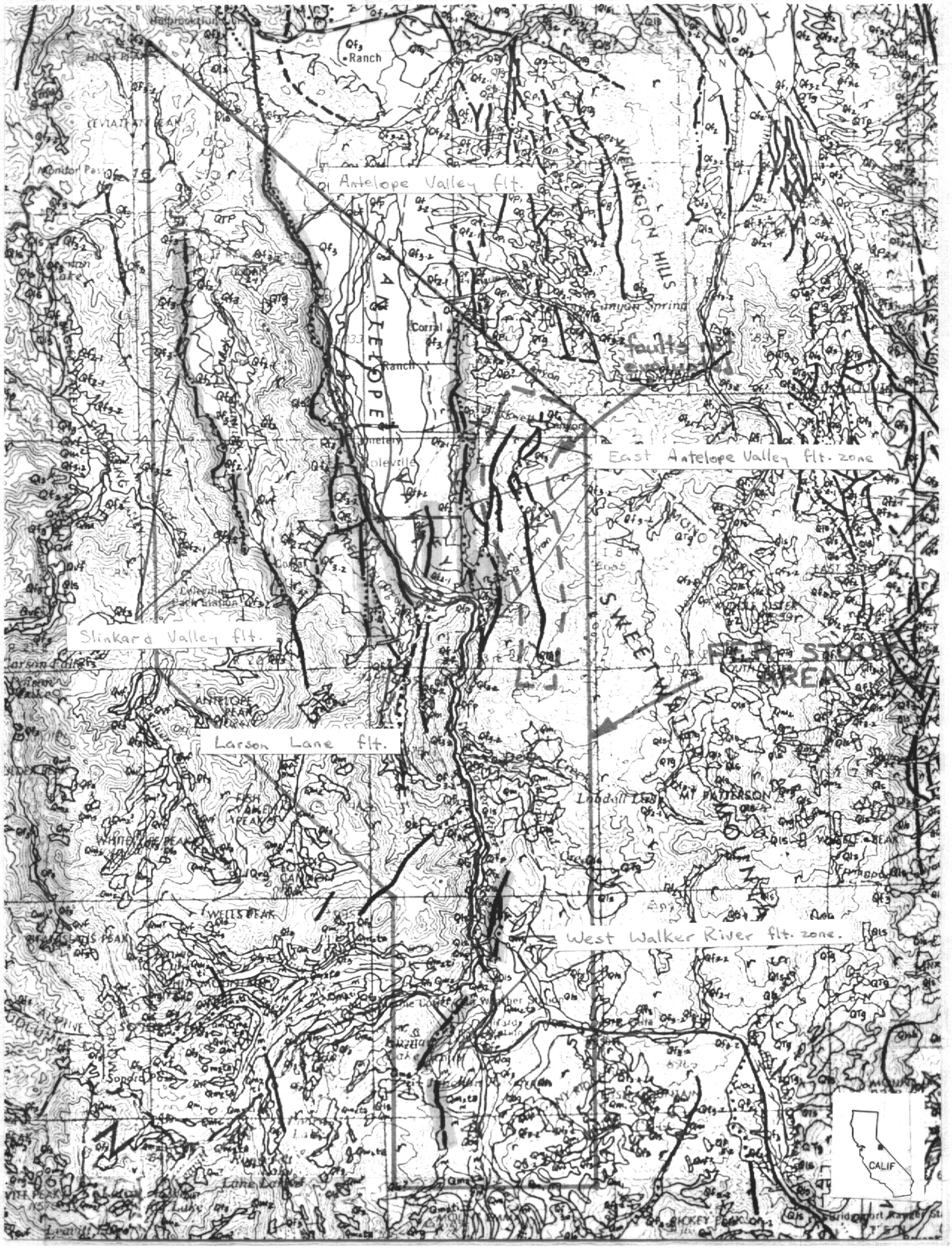

Figure 1 (to FER-154). Location of faults within the Antelope Valley-Sonora Junction FER study area. Base map from Dohrenwend (1982a).

Figure 4 (to FER-154). Seismicity plot in the FER study area for the period 1900 to 1974 (Real, et al., 1978). Quality of data is A through D. Base map is from Koenig, 1963.