FER-129

CALIFORNIA DIVISION OF MINES AND GEOLOGY
FAULT EVALUATION REPORT FER-129
April 13, 1982

1. Name of fault

West Napa fault zone and Soda Creek (east Napa) fault.

2. Location of fault

Cuttings Wharf, Napa, Yountville, and part of Cordelia 7.5-minute quadrangles (Napa County).

3. Reason for evaluation

Part of 10-year fault evaluation program (Hart, 1980).

4. List of References

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5. Review of available data, air photo interpretation, and field checking.

WEST NAPA FAULT ZONE

Faults in the hills west of the City of Napa were first mapped by Weaver (1949). Fox, et al. (1973) mapped a north northwest-trending zone of faults along the foot of the hills west of Napa and along the east side of Browns Valley (figure 1). Fox, et al. mapped Pleistocene and probable Holocene deposits as offset by the West Napa fault zone in the area north and south of Redwood Creek (figure 2b). Helley and Herd (1977) extended the West Napa fault zone southeast to Oat Hill in the Cuttings Wharf quadrangle (figure 2a).

The sense of displacement along the West Napa fault zone is thought to be right-lateral strike-slip with a component of vertical displacement, down on the east (Helley and Herd, 1977). The magnitude of offset is not known, although at least 80 feet of apparent vertical offset has occurred since the beginning of Pleistocene time, based on the height of an east-facing scarp in older alluvial fan deposts just north of Redwood Creek (Helley and Herd, 1977; Fox, et al., 1973).

Much of the land along the foothills west of Napa, in Browns Valley, and in the vicinity of Yountville has been modified by grading for residential development. Extensive agricultural activity has occurred along most of the West Napa fault zone.

CUTTINGS WHARF QUADRANGLE

The West Napa fault zone in the Cuttings Wharf quadrangle is a generally well-defined, northwest-trending zone of discontinuous faults in Pleistocene and Holocene alluvium (figure 2a). The southeastern extension of the West Napa fault zone was first mapped by Helley and Herd (1977). Subsequent mapping of the West Napa fault zone by Herd (in press) is generally similar to faults mapped by Helley and Herd (1977), although significant differences in detail exist, mainly to the northwest. (Fault traces of Helley and Herd shown in this FER are plotted from a 1:125,000-scale map; accuracy of fault traces is, therefore, about ± 150 feet).

Southeast of Oat Hill the West Napa fault is characterized by a well-defined tonal contrast and subtle scarp in older alluvium of Fox, et al. (1973) (locality 1, figures 2a, 3a). Vague geomorphic evidence of recent faulting was observed along the northeast side of Oat Hill (Helley and Herd, 1977; Herd, in press; Bryant, figure 3a, this report), suggesting that this hill may be a pressure ridge. The fault is poorly defined on the northeast side of Oat Hill, but to the northwest it is characterized by well-defined geomorphic features in alluvium indicating Holocene active faulting (tonal lineaments, scarps in alluvium, right-lateral deflected drainages, closed depressions) (figure 3a)

Helley and Herd (1977) map two sub-parallel faults just north of Oat Hill, but a later map by Herd (in press) depicts only one fault trace. Air photo interpretation by Bryant (this report, figure 3a) generally agrees with the later map of Herd (in press) (figure 2a). No geomorphic evidence of recent faulting was observed along the two sub-parallel faults of Helley and Herd (figure 2a).

The West Napa fault is well-defined in the vicinity of Napa airport. Geomorphic features such as linear vegetation contrasts, scarps in Holocene alluvium, deflected drainage, and possible closed depression, strongly indicate Holocene faulting (figure 3a). Fault traces mapped by Herd (in press) and Bryant (this report) agree in general, but the fault trace of Helley and Herd is located about 300 to 400 feet to the east. No geomorphic evidence of recently active faulting was observed along the fault trace of Helley and Herd, although it is possible that the fault trace was mislocated when transferring fault locations from small-scale to large-scale maps.

The Napa airport, built in 1941, is constructed on natural ground with minimal fill at the southwest end of the runways (W. Partain, airport manager, p.c., December 1981). Little to no grading was performed in the area between the two runways, and no drainage devices are located near the trace of the West Napa fault (Partain, p.c.). Thus, it is unlikely that the sharp tonal lineaments through the airport are artificial.

North of the Napa airport, the West Napa fault zone is less well-defined and is discontinuous (figure 2a, 3a). Helley and Herd map short, discontinuous faults near Home Hill (locality 2, figure 2a), but Herd (in press) and Bryant (this report) did not observe geomorphic evidence of recent faulting north of the Napa River (figures 2a, 3a).

Branch fault A

A 4,000-foot long, northwest-trending fault just east of Carneros Creek (branch fault A) is mapped by Herd (in press) and Bryant (this report) (figures 2a, b, 3a,b). Helley and Herd mapped a short fault about 700 to 800 feet to the east, but there is no geomorphic evidence supporting this location (figure 2a). Branch fault A is generally well-defined and is characterized by an east-facing scarp offsetting Plio-Pleistocene Glen Ellen Formation (?) against older alluvium. An incised, possibly right-lateral deflected drainage and possible closed depressions suggest Holocene faulting (figures 3a, 3b). However, the close association of these features with areas modified by man implies that processes other than Holocene faulting could have formed these features.

NAPA QUADRANGLE

The West Napa fault zone is not well-defined throughout most of the Napa quadrangle (figures 2b, 3b). Fox, et al. (1973) map a 2,000-foot wide zone of northwest-trending faults that generally offset Pliocene Sonoma Volcanics against Cretaceous and Eocene sedimentary rocks. Helley and Herd (1977) map a zone of discontinuous faults similar to the faults mapped by Fox, et al., although significant differences in detail exist (figure 2b). Herd (in press) maps a single, slightly sinuous fault along the foot of the east-facing slope west of Napa (figure 2b).

Branch fault B

North of Browns Valley Creek, Fox, et al. depict the West Napa fault (branch fault B) as recently active, based on youthful geomorphic features and the offset of Quaternary deposits. Just north of Browns Valley Creek, branch fault B is concealed by Holocene alluvium (Fox, et al.) (locality 3, figure 2b). Older, late Pleistocene alluvium is offset along the trace of branch fault B (Fox, et al.). North of Redwood Creek,Fox, et al. indicate that Holocene alluvium is faulted against dissected Pleistocene alluvial fan deposits (locality 4, figure 2b).

Faults mapped by Helley and Herd (1977) generally agree with Fox, et al. in the vicinity of Redwood Creek, although differences in detail exist (figure 2b). Herd (in press) also maps a northwest-trending fault north of Redwood Creek, but he depicts the fault as concealed by Holocene alluvium (figure 2b). The east-facing scarp north of Redwood Creek is dissected and no geomorphic evidence of Holocene faulting was observed by this writer, based on air photo interpretation and brief field checking (figure 3b). Alluvial fans are deposited across the fault with no evidence of offset and small drainages that cross the fault show no evidence of offset.

There is no evidence of offset of Redwood Creek. The drainage is incised in late Pleistocene to early Holocene flood-plain deposits, and at least one stream terrace below the flood plain can be observed along the drainage course of both Redwood Creek and Browns Valley Creek. It is assumed that the flood-plain deposits are latest Pleistocene to early Holocene in age, deposited as the result of eustatic changes in sea level at the end of the Wisconsin period of glaciation (Shackleton and Opdyke, 1973).

South of Browns Valley geomorphic evidence of recent faulting along branch fault B was not observed by Herd (in press) or Bryant (this report).

Just east of Redwood Creek a short fault sub-parallel to branch fault B is mapped as recently active by Fox, et al. and Herd (in press) (locality 5, figure 2b). This short fault segment was trenched by Moore and Taber in 1974 (figures 2b, 3b). No evidence of faulting was observed in the trench.

Two site investigations involved trenching across branch fault B (Engeo, 1977, 1979) (figures 2b, 3b). One trench (Engeo, 1977) exposed evidence permissive of Holocene faulting, but three additional trenches excavated across the projected trend of the feature did not expose evidence of faulting. However, these three trenches generally were inadequate in length (15 to 50 feet long). The fault observed in the northernmost trench dipped 60 to the east in the upper 8 feet of the trench, then dipped almost vertically. The fault, which offsets andesite against Cretaceous(?) claystone, extends to within 2-1/2 feet of the surface and apparently offsets soil about 7 inches. Sense of apparent vertical displacement is reverse, east side up. The feature exposed in the trench is not associated with any specific geomorphic features indicating recently-active faulting and does not coincide with any mapped fault. An arcuate scarp east of the trench and the subdued, hummocky topography suggest that landsliding should be considered as a contributing cause of the observed features in the trench.

Engeo (1979) excavated two trenches that exposed evidence of faulting across the projected trace of branch fault B (figures 2b, 3b). A shallow east-dipping fault (N20 W 31 NE) offsetting andesite (on the east) over older alluvium(?) was exposed in the southern trench. About 2-1/2 feet of unfaulted colluvium overlies the fault zone. The northern trench exposed andesite faulted against claystone, but the fault plane dipped steeply to the west (Engeo, 1979). A "sharply-dipping finger of soil" over the fault contact was interpreted to be evidence of geologically young faulting (Engeo, 1979). However, it is more likely that the soil was formed by weathering of the sheared material within the fault zone (J. Sweeney, p.c., January 1982), or perhaps by minor lateral spreading. Geomorphic evidence indicating Holocene faulting is weak along this segment of branch fault B and includes a sidehill bench (probably landslide related), a tonal lineament, and a linear trough (?) (figure 3b).

Branch fault C

Branch fault C is located generally along the base of the east-facing slope west of the City of Napa (figure 2b). Fox, et al. (1973) map branch fault C as concealed by alluvium (Qof, late-Pleistocene?) along a major portion of its north northwest trend, except at locality 6 (figure 2b), where volcanic tuff is offset against Holocene alluvium. Helley and Herd(1977) map short, discontinuous faults along a similar trend just south of Redwood Creek (figure 2b). Herd (in press) maps branch fault C as concealed by Holocene alluvium along its entire trace, including the segment mapped by Fox, et al., as cutting Holocene alluvium (locality 6, figure 2b).

Branch fault C is generally not well-defined, except for very short, discontinuous segments characterized by linear scarps and tonal lineaments, based on air photo interpretation by this writer (figure 3b). There is no geomorphic evidence of recent faulting along most of the trace of branch fault C. Redwood and Browns Valley Creeks are not offset, and the small drainages along the east-facing slopes show no evidence of systematic offset.

Trenches were excavated across branch fault C by Western Geological Consultants (1979, 1980) (figures 2b, 3b). Two trenches excavated across an east-facing scarp did not expose evidence of faulting (Western Geological Consultants, 1979). One trench excavated by Western Geological Consultants (1980) just south of Browns Valley Road exposed evidence of possible faulting (figures 2b, 3b). The fault offsets claystone (Cretaceous ?; Fox, et al. map volcanic tuff at this location) on the west (bedding attitude not recorded) against vertically oriented claystone on the east. The fault strikes N 10 W and dips 75 E, with an apparent reverse sense of offset, west side down.

The contact between the claystone and overlying soil is offset about 1 foot, west side down. The sense of offset is inconsistent with the inferred sense of displacement observed from geomorphic and strati-graphic evidence elsewhere along branch fault C. Geomorphic evidence of recent faulting was not observed along the projected trace of the fault exposed by Western Geological Consultants (1980). A tonal lineament and possible closed depression observed by this writer about 110 feet east of the exposed fault were trenched to a depth of about 7 feet, and no evidence of faulting was observed (Western Geological Consultants, 1980). The incorrect sense of displacement and lack of geomorphic features indicating recent faulting suggest that other processes, such as streambank erosion, may have formed the features observed in the trench.

Branch fault D

Branch fault D, mapped by Fox, et al. (1973) and Helley and Herd (1977), is a short fault that splays to the west from branch fault C (locality 7, figure 2b). North of Browns Valley Creek the fault is mapped based on aligned saddles and a linear hill front (figure 2b). These geomorphic features can also be formed by differential erosion.

Engeo (1979) trenched across a saddle northwest of branch fault D and did not observe evidence of faulting (figures 2b, 3b). No geomorphic evidence of recent faulting was observed in the alluvium near Browns Valley Creek, based on air photo interpretation by this writer (figure 2b). (See discussion of branch fault C for review of trench excavation at junction of branch faults C and D). Herd (in press) did not observe evidence of recent faulting along branch fault D.

Branch fault E

Fox, et al. (1973) and Helley and Herd (1977) map an inferred fault (branch fault E) near the east-facing slope at locality 8, figure 2b. The location and inferred activity of branch fault E was probably based on a left-laterally deflected drainage (figure 2b). No additional geomorphic evidence of recent faulting was observed by this writer, based on air photo interpretation. Harding-Lawson (1979) concluded, based on a reconnaissance site investigation consisting of air photo interpretation and siteinspection, that recently-active faults were not present and that the deflected drainage had been diverted by man (figure 2b).

Branch fault F

Branch fault F, a previously unmapped north-northwest trending fault, is located west and southwest of Congress Valley (figure 3b). Geomorphic evidence of recent activity along this fault is indicated by tonal lineaments in alluvium and a right-laterally deflected drainage (locality 12, figure 3b). Branch fault F cannot be followed south of Henry Road (figure 3b).

North of locality 12, branch fault F is delineated primarily by geomorphic features characteristic of differential erosion along a fault rather than surface fault rupture. Deflected and linear drainages at locality 13 may be caused by recent faulting, but drainages to the south are not offset (figure 3b). It is likely that the deflected and linear drainage at locality 13 are erosional.

YOUNTVILLE QUADRANGLE

Discontinuous, inferred faults are mapped by Fox, et al. (1973) and Helley and Herd (1977) in the southwestern part of the Yountville quadrangle (figure 2c). An east-facing, dissected scarp in Pleistocene alluvium along the eastern part of Yountville defines the northern extent of the West Napa fault zone. Holocene alluvium is not offset by this fault at locality 9, figure 2c (Fox, et al., 1973). A right-laterally deflected drainage at locality 10, (figures 2c, 3c) may have been diverted by man, since other drainages in this area have been modified. Helley and Herd (1977) extend the fault farther north, but no geomorphic evidence of recent faulting was observed by this writer (figures 2c, 3c).

South of Yountville, Fox et al. and Helley and Herd map two short segments of the West Napa fault (figure 2c). No geomorphic evidence indicating recent faulting was observed by this writer, based on air photo interpretation, except at locality 11, where a sharp tonal lineament (ground-water barrier ?) is associated with a subtle, east-facing scarp (or trough ?) in alluvium (figures 2c, 3c).

Herd (in press) maps two short fault segments located south and southwest of the faults mapped by Fox, et al. and Helley and Herd (figure 2c). No geomorphic evidence of recent faulting was observed along the fault traces of Herd (in press), based on air photo interpretation by this writer (figure 2c).

SODA CREEK FAULT (EAST NAPA FAULT)

The Soda Creek fault (East Napa fault) was mapped as recently active in the Napa quadrangle by Fox, et al. (1973). This map is not annotated, but the map explanation indicates that fault activity is inferred from topographic features thought to be produced by surface faulting. The sense of offset along the Soda Creek fault is not known, although a vertical to near vertical fault plane is indicated by the linear fault trace mapped by Fox, et al. Helley and Herd (1977) and Herd (in press) did not observe evidence of recent faulting along the Soda Creek fault.

There is no geomorphic evidence of recent activity along the Soda Creek fault, based on air photo interpretation by this writer (figures 2b, 2c). A lack of systematic offset of drainages, unfaulted Holocene and late-Pleistocene deposits, and relatively few tonal lineaments connecting saddles in bedrock strongly indicates that the Soda Creek fault is not active (figures 2b, 2c). The Soda Creek fault as mapped by Fox, et al. in the Napa quadrangle and southern Yountville quadrangle is difficult to identify on aerial photographs and, therefore, it cannot be considered to be a well-defined fault.

6. Conclusions

WEST NAPA FAULT ZONE

The West Napa fault zone is a north northwest-trending zone of right-lateral strike-slip faults that have a component of vertical offset (Helley and Herd, 1977). The magnitude of strike-slip offset is not known, but about 80 feet of vertical offset, west side up, has occurred during Pleistocene time (Helley and Herd, 1977).

Geomorphic evidence of Holocene activity along the West Napa fault zone was observed south of Napa in the Cuttings Wharf quadrangle (figures 2a, 3a). The fault zone is characterized by well-defined features such as sharp tonal lineaments and scarps in late-Pleistocene and Holocene alluvium that are associated with right-laterally deflected drainages and possible closed depressions (figure 3a).

West of the main zone of the West Napa fault a 4,000-foot long branch fault (branch fault A) was mapped by Herd (in press) and Bryant (this report). Although this fault is well-defined, geomorphic features indicating Holocene activity (incised drainage across scarp, possible closed depressions) may also have been formed as the result of agricultural and grading activities of man.

The West Napa fault zone is not well-defined north of the Napa River. There is evidence of pre-Holocene faulting (fault scarp in older alluvium, locality 4, figure 2b), but well-defined geomorphic features characteristic of right-lateral strike-slip faulting were not observed by this writer. Browns Valley Creek and Redwood Creek are not deflected and minor drainages that cross branches of the West Napa fault zone do not show evidence of systematic offset during Holocene time. However, it is possible that a very small rate of displacement occurs along the West Napa fault zone. Thus, the rate of erosion may be greater than the rate and magnitude of surface fault rupture, resulting in the obliteration of geomorphic features of surface fault rupture in the the Napa and Yountville quadrangles.

Geomorphic evidence of Holocene faulting along branch fault B is not well-defined (figures 2b, 3b). Fox, et al. (1973) map unfaulted Holocene alluvium in Browns Valley along the trace of branch fault B, but show faulted Holocene alluvium where the fault crosses Redwood Creek (figure 2b). Helley and Herd (1977) map branch fault B similar to Fox, et al. (1973) just south and north of Redwood Creek (figure 2b). In a subsequent map, Herd (in press) did not observe geomorphic evidence of recent faulting south of Redwood Creek. North of Redwood Creek, Herd (in press) maps branch fault B as concealed by Holocene alluvium (figure 2b). Bryant (this report) did not observe geomorphic evidence of Holocene faulting along branch fault B (figures 2b, 3b). Engeo (1977, 1979) exposed evidence of reverse and reverse oblique(?) offset along branch fault B, but evidence mandatory of Holocene activity was not observed.

Faults concealed by late-Pleistocene to Holocene alluvium (branch fault C) are mapped along the base of the east-facing slope west of Napa by Fox, et al. (1973) and Herd (in press) (figure 2b). Although Herd (in press) mapped the entire trace of branch fault C as concealed, Fox, et al. depict a short segment of branch fault C as offsetting Sonoma Volcanics against Holocene alluvium (locality 6, figure 2b). A linear scarp (fault-line scarp) was observed by Bryant (this report), but Holocene alluvium north and south of this feature was not offset (figures 2b, 3b). Neither Redwood Creek nor Browns Valley Creek are offset by branch fault C.

Site investigations across branch fault C reveal conflicting evidence. Western Geological Consultants (1979) excavated two trenches across the concealed trace of branch fault C and did not observe evidence of faulting (figures 2b, 3b). Farther north, Western Geological Consultants (1980) exposed possible evidence of Holocene faulting, but the sense of offset (west side down) is inconsistent with the expected vertical component of offset (figure 2b). It is possible that streambank erosion may have formed the observed feature.

Geomorphic evidence of Holocene faulting was not observed by this writer and Herd (in press) along branch faults D and E (figures 2b, 3b). Faults south of Yountville in the Yountville quadrangle mapped by Fox, et al.

(1973), Helley and Herd (1977), and Herd (in press) are not well-defined, except at locality 11 (figure 2c), where a short fault segment is characterized by a tonal lineament associated with a subtle scarp (trough ?) in Holocene alluvium (figure 3c). This fault can be observed for only 1,500 feet, and may be formed by an old stream channel rather than faulting.

Geomorphic evidence of possible Holocene faulting along branch fault F includes a well-defined tonal lineament in alluvium mapped as Holocene by Fox, et al. (1973), and a right-laterally deflected drainage (locality 12, figure 3b). There is no evidence of faulting south of Henry Road and north of locality 12 geomorphic evidence such as linear drainages, a right-laterally deflected drainage, and saddles are probably erosional. However, the well-defined portion of branch fault F extends for only about 2,500 feet, and the probability of significant future surface fault rupture may be slight.

The east-facing scarp in Yountville mapped by Fox, et al. (1973) and Helley and Herd (1977) is no doubt due to faulting, but geomorphic evidence of Holocene faulting was not observed by Herd (in press) or Bryant (this report). The scarp has been modified by erosion and a right-laterally deflected drainage may have been diverted by man (figures 2c, 3c).

SODA CREEK FAULT (EAST NAPA FAULT)

The Soda Creek fault mapped by Fox, et al. (1973) generally is poorly-defined in the Napa and Yountville quadrangles (figures 2b). Helley and Herd (1977) and Herd (in press) do not map this fault as Quaternary-active. Geomorphic evidence of recent faulting along the Soda Creek fault was not observed by Bryant (this report). The Soda Creek fault is not sufficiently active or well-defined.

7. Recommendations

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

and Cordelia Zone for special studies those traces of the West Napa fault zone in the Cuttings Wharf quadrangles shown in figure 4, based on Herd (in press) and Bryant (this report, figure 3a).

Do not zone for special studies traces of the West Napa fault zone in the Napa quadrangle (branch faults, A, B, C, D, E, F) or the Yountville quadrangle. These faults are not sufficiently active or well-defined.

Do not zone for special studies traces of the Soda Creek fault mapped by Fox, et al (1973). These faults are not sufficiently active or well-defined.

8. Report prepared by William A. Bryant, April 13, 1982.

William A. Bryant

I concur with
the recommendations
Earl W. Hart
5/10/82