UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

MAP OF FAULTING ACCOMPANYING THE 1966 PARKFIELD, CALIFORNIA, EARTHQUAKE

by

James J. Lienkaemper[1]

and

Robert D. Brown[1]

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This report is preliminary and has not been reviewed for conformity with U. S. Geological Survey editorial standards and stratigraphic nomenclature.

[1] U.S. Geological Survey
345 Middlefield Road, MS/977
Menlo Park, CA 94025

INTRODUCTION

Tectonic ground ruptures along the San Andreas fault accompanying the June 27, 1966 Parkfield, California earthquake were described by Brown and Vedder (1967) and others in U.S. Geological Survey Professional Paper 579. This explanation accompanies a newly compiled 1:12,000–scale map (in 3 sheets) of the faulting in 1966. Details of the rupture shown on this map are based primarily on the field-annotated 1:6,000–scale air photos used to map the surface rupture in June–July 1966 and secondarily on field-annotated 1:24,000 topographic maps in areas of incomplete photo coverage. The purpose of this map is to make available more details of the rupture geometry than could be shown on the existing 1:62,500–scale map (Brown and Vedder, 1967) and to add some observation localities which may help geologists make comparative observations in the next Parkfield earthquake. A minimum of geologic observations are noted directly on the map in order to make it suitable as a basemap for multidisciplinary use in the U.S. Geological Survey's Parkfield prediction experiment (Bakun and Lindh, 1985).

The next Parkfield rupture is expected to occur in early 1988 $\pm$ 5.2 years (95% confidence interval), Bakun and Lindh (1985). The U.S. Geological Survey has intensified its efforts to predict the next earthquake even more precisely. This more detailed map of last rupture should help in the deployment of various slip and strain detection systems to identify precursors of the next one. The timing of slip in 1966 remains enigmatic; many workers arriving promptly on the scene of the next rupture will be able to use this map as a basis for locating the rupture quickly and comparing the rates of fracture propagation.

SYMBOL EXPLANATION

Three abbreviations are used: ED (expanded dessication cracks), LS (landslide), and PC (parallel, subparallel cracks). Locality numbers refer to Table 1. Miscellaneous cultural and natural features are locally explained on the map; they are included to make future relocation of the fault trace more accurate.

Faulting is depicted in two ways: (1) fine pen line for fractures mapped on 1:6,000–scale air photos, and (2) large rectangular boxes show the trace as mapped directly on 1:24,000 topographic maps. Most faulting was mapped on air photos; however major

sections on Middle Mountain (sheet 3) and the Southwest Fracture Zone (sheets 2 and 3) were mapped on topographic maps. Dotted segments of fault are inferred to have been throughgoing, but were obscured or inaccessible at the time of mapping. Queries indicate doubt about tectonic origin of cracks. Most queried sites are commented upon in Table 1.

Timing of fracture growth is important for this faulting episode and was discussed in detail by Brown and Vedder (1967), Wallace and Roth (1967), and Yerkes and Castle (1967). Dates in Table 1 come from Brown and Vedder (1967); dates and times were not recorded on the air photos nor on the topographic maps used in the original field mapping. The size of the fractures and the zone itself depended on the date of recording. Length of fractures and width of the fracture zones are plotted schematically in the map sheets, and are generally exaggerated above their true size, as is apparent by comparing Table 1 values to the map. The symbolic representation of *en echelon* fractures is based on the transfer of lines on the original 1:6,000–scale air photos using a stereoplotting instrument. The trace is nearly identical to the style of mapping used in the field, although minor generalization was necessary in places to maintain clarity in inking the trace at a reduced scale. In most places the accuracy of location is estimated to be $\pm$ 10 m because field workers could use individual bushes, fence lines, and small drainage features for location. However in the area of braided stream channels in Cholame Valley field control was poorer. The addition of cultural and natural features to the map, particularly in nondescript areas on the topographic map should help map users to benefit from the original large-scale air photo mapping. Those needing more detail may consult the original air photos.

Map accuracy for Middle Mountain and the Southwest Fracture Zone is considerably less, as is reflected in the use of larger symbols; these symbols, like the others, are careful optical transfers of the marks made in the field.

TABLE EXPLANATION

Table 1 incorporates data from Table 2 of Brown and Vedder (1967) with numerous other locality data available on the air photos. Note localities of Brown, Vedder, and Kachadoorian were marked by pin holes in the photos. The original notes by Brown were used to supplement Table 1; the others are currently missing. The mapping done on

topographic maps (1:24,000 scale) also contained annotations which were used in Table 1. Minor differences in observations at localities common to both Table 1 of this study and the Table 2 of Brown and Vedder (1967) result from assuming field note values to be correct. Current names are used for roads where present usage differs from that in 1966.

ACKNOWLEDGMENTS

Special thanks to Peter A. Brink whose combined understanding of geology and topographic mapping made this fault trace better located than most; also to Donald A. Mertz and Wayne M. Kobayashi, all three of whom took time from normal duties in the U.S.G.S. National Mapping Division to set up numerous difficult stereomodels.

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Table 1. Observations on faulting accompanying the June 27, 1966 Parkfield, California earthquake.

	Fracture					Zone					
#[1]	Azim.[2]	L (ft.)[3]	S (ft.)[4]	RL (in.)[5]	E (in.)[6]	Azim.[2]	W (ft.)[7]	Obs.[8]	Codes[9]	#[1]	Remarks
1	345–355	3	—	0.5	2	325	—	S 7–1	F28, R–7, QH	1	South end of mapped rupture. Irregularly spaced fractures.
2	335–340	7	2–6	1.0–1.4	1.2	331	10	S 7–1	F27	2	Meng Rd., paved. SE side up 1 inch.
3	—	—	—	—	—	—	—	A —	R8	3	Monument at crest of small promintory 10 m W of pipeline.
4	342–350	15	—	—	—	324	4	V 6–30	F26	4	S side down. SE locality had some parallel cracks, some mole track.
5	344–360	10	—	—	—	315–323	5–15	V 6–30	F25, R–1	5	Mole track S of Highway 46.
6	—	—	—	—	—	—	—	S —	R–2	6	R–1 and R–2 locations, J. Schlocker, unpub. data, 1966.
7	350–355	6	2–10	—	3	323	3–4	V 7–1	F24	7	Mole track at places NW of here.
8	340	—	—	—	—	—	—	A —	—	8	—
9	350	—	—	—	—	—	—	A —	—	9	—
10	340	—	—	—	—	—	—	A —	—	10	—
11	350	—	—	1.5–2	1–2	—	—	A —	—	11	—
12	348–012	15	7	2	5.5	322	—	S 6–30	F23, R–3, K–3, QAB	12	"Water Tank" locality. Fence built in 1908 is offset. Scissors, see site 13.
13	355–010	—	2–5	2–3	4	330	5.5	S 6–30	F22, R–5, K–5	13	Scissors faulting: E side up 1–2 in. at S end, W side up 1–2 in. at N end.
14	—	—	—	—	—	—	—	K —	K–6	14	Pin-holed air photo locality. Notes missing.
15	328	—	—	—	—	328	—	A —	—	15	Cracks parallel to zone.
16	355–015	20	1–50	—	1	325	5	S 6–30	F21, R–6	16	—
17	010–040	3–4	3–4	—	0.5	348	1–5	S 7–1	F20, K–9, QD	17	Cholame Valley Rd. pavement not cracked 6/29/66. Cracks seen 6/30/66.
18	345	4–12	—	—	1–2	320	—	B 7–5	F19, B–2	18	Thick grass cover.
19	350	20	1–3	1.5–2.5	2	320	20±	B 7–5	F18, B–1	19	Mole tracks and pressure ridges. Jack Ranch, in Cholame Creek.
20	005	2–3	—	—	—	005	2.5–3	B 7–6	F17, B–3	20	Linear fractures.
21	345	—	—	—	1	345	—	A —	—	21	Linear cracks; no *en echelon*.
22	350	2	2–10	—	< 1.5	310	6	B 7–6	F16, B–4	22	—
23	350	—	—	—	1	315	15	A —	—	23	Pin-holed air photo locality; notes on back of photo.
24	335	20	2–6	—	1	320–360	2	B 7–6	F15, QG	24	Pin-holed air photo locality; notes on back of photo.
25	320–360	—	—	—	1	320–360	—	B 7–6	F15, B–5	25	Linear cracks follow abandoned channel riser; no cracks on younger riser.
26	—	—	—	—	—	—	—	A —	—	26	Ground torn up by cattle.
27	—	2	—	—	—	—	1	A —	—	27	—
28	335	2	3	—	—	320	3	B 7–6	F14	28	Width from air photo note. Fracture trend, R.D. Brown, unpub. map.
29	335	2	—	—	1	—	—	M —	—	29	—
30	340	2	—	—	1	310	3	B 7–6	F13	30	Dirt road.
31	—	—	—	—	—	318	—	V 7–6	V–1	31	Irrigation pipe broken about 9 hrs. before June 27 earthquake.

Table 1. Observations on faulting accompanying the June 27, 1966 Parkfield, California earthquake (Continued).

	Fracture					Zone					
#[1]	Azim.[2]	L (ft.)[3]	S (ft.)[4]	RL (in.)[5]	E (in.)[6]	Azim.[2]	W (ft.)[7]	Obs.[8]	Codes[9]	#[1]	Remarks
32	337	6–12	1–5	—	1.5	318	3–4	V 7–6	F12	32	May actually be at #31; Vedder notes are missing.
33	350	—	—	—	—	—	—	* —	—	33	*En echelon.*
34	—	—	—	—	—	—	—	* —	—	34	Cracking here.
35	—	—	—	—	—	—	—	* —	—	35	Uncut wheat field.
36	—	—	—	—	—	—	—	* —	V–2	36	Subparallel ruptures; tectonic?
37	—	—	—	—	—	—	—	* —		37	Cracks.
38	338	—	—	—	—	—	—	* —	—	38	*En echelon.*
39	—	—	—	—	—	—	—	* —	—	39	Fracturing, direction uncertain.
40	—	—	—	—	—	—	—	* —	—	40	Nothing seen.
41	320–324	40	—	—	—	—	—	* —	—	41	—
42	—	—	—	—	—	—	—	* —	—	42	Small fractures, irregular pattern.
43	—	—	—	—	—	—	—	* —	—	43	Fractures.
44	—	—	—	—	—	—	—	* —	—	44	Not seen.
45	345–355	4–6	3.5	—	0.5	318	—	V 7–6	F11, V–3	45	Wooded; thick grass cover.
46	345–350	1–8	1.5	—	0.5	316	4	V 7–6	F10, V–4	46	Cholame Rd. pavement.
47	—	—	—	—	—	—	—	V —	V–5	47	Vedder notes missing.
48	—	—	—	—	—	—	—	V —	V–6	48	Vedder notes missing.
49	348	—	—	—	—	—	—	* —	—	49	*En echelon.*
50	—	—	—	—	2	—	—	* —	—	50	Subparallel cracks to 2" wide.
51	349–352	—	—	—	0.75	—	—	* —	—	51	—
52	—	—	—	—	—	—	—	* —	—	52	Crack on canyon wall.
53	—	—	—	—	—	—	—	* —	—	53	Cholame Rd. pavement. Subparallel cracks; landslide.
54	323	—	—	—	—	—	—	* —	—	54	Crack in Cholame Rd. pavement and NE shoulder.
55	349–355	6	1–3	—	0.5	316	2–3	V 7–6	F9, V–7	55	—
56	345	—	—	—	1.5	—	30	B 7–6	B–6	56	Turkey Flat Rd. Opening measured in plowed field N of road.
57	340	20	2–3	0	2–3	320	6	B 7–6	F8, B–7	57	—
58	—	—	—	—	—	—	—	* —	—	58	Plowed field.
59	345	8–10	1–2	0	1–2	320	10	B 7–6	F7, B–8	59	"...fresh-appearing *en echelon* cracks—" 6-16-66, Allen & Smith (1966).
60	—	—	—	—	—	—	—	* —	—	60	Heavy stubble; fracture zone obscure.

Table 1. Observations on faulting accompanying the June 27, 1966 Parkfield, California earthquake (Continued).

	Fracture					Zone					
#[1]	Azim.[2]	L (ft.)[3]	S (ft.)[4]	RL (in.)[5]	E (in.)[6]	Azim.[2]	W (ft.)[7]	Obs.[8]	Codes[9]	#[1]	Remarks
61	350	15	1.5	—	1	317	—	B 7-6	F 6	61	—
62	—	—	—	—	—	—	—	* —	—	62	No fractures in dam.
63	348-354	8	—	—	—	322	2	V 7-6	F5	63	—
64	015	3	1.5	—	1	330	3	B 7-7	F4	64	—
65	340	25	—	—	—	—	—	M —	—	65	—
66	351	6	2-3	—	2	319	12	B 7-13	F3	66	Zone width from R.D. Brown, unpub. map.
67	343-347	12	12	—	—	323	3-4	V 7-13	F2	67	QJ near here.
68	346	5	—	—	—	323	2	V 7-13	F1	68	Irregularly spaced fractures.
			Southwest Fracture Zone								
69	315	—	—	—	—	—	1-2	M —	—	69	"Weak."
70	300	10-15	—	—	—	—	10	M —	—	70	Parallel linear cracks.
71	360	6-8	1-2	1	2	335	3	B 7-14	F33, B-10	71	Hellman Ranch.
72	345	3	2	—	—	290	—	M —	—	72	—
73	340	15	1.5	—	0.5	320	15	B 7-14	F32	73	—
74	—	—	—	—	—	—	—	M —	—	74	Gap in faulting.
75	325-005	—	—	2.6	—	320—358	12	B 7-7	F31, B-9, QI	75	RL from 2" offset in fence last realined 1963. Ranchita Canyon Rd.
76	010	—	—	—	—	—	—	M —	—	76	—
77	350	6	1-3	—	0.5	325	6	B 7-14	F30	77	Mislocated in Brown and Vedder (1967) figure 2.
78	318	4-5	1	0.5	0.5	311	6	B 7-14	F29	78	Vineyard Canyon Rd. pavement. Fracture trend from R.D. Brown, unpub. map.

[1]Locality number used on map, Sheets 1, 2, and 3. Numbers 1-68 are along the San Andreas fault from south to north.
[2]Azimuth 0° is true north increasing clockwise to 360°, also true north.
[3]L is maximum length of fractures.
[4]S is spacing between fractures.
[5]RL is right-lateral separation on fractures, except for site #75.
[6]E is extensional component of separation on fractures.
[7]W is width of fracture zone.
[8]Obs.—observer: A-air photo data, observer not explicitly known; B—R.D. Brown; M—Brown and Vedder, unpublished map with miscellaneous field observations; S—J. Schlocker; V—J.G. Vedder; *—Brown and Vedder notes.
—month and day, in 1966, of observation from Table 2 of Brown and Vedder (1967).
[9]Codes: F12 locality no. used in Brown and Vedder (1967).
B-8 pin-hole in air photo and notebook number of R.D. Brown notes used to supplement this table.
K-5 pin-hole in air photo and notebook number of R. Kachadoorian; notes missing.
V-3 pin-hole in air photo and notebook number of J.G. Vedder; notes missing.
R-4 pin-hole in air photo; benchmarks installed in 1966 fractures; except R-1 and R-2 not pin-holed.
QH quadrilateral for measuring afterslip; see Wallace and Roth (1967).

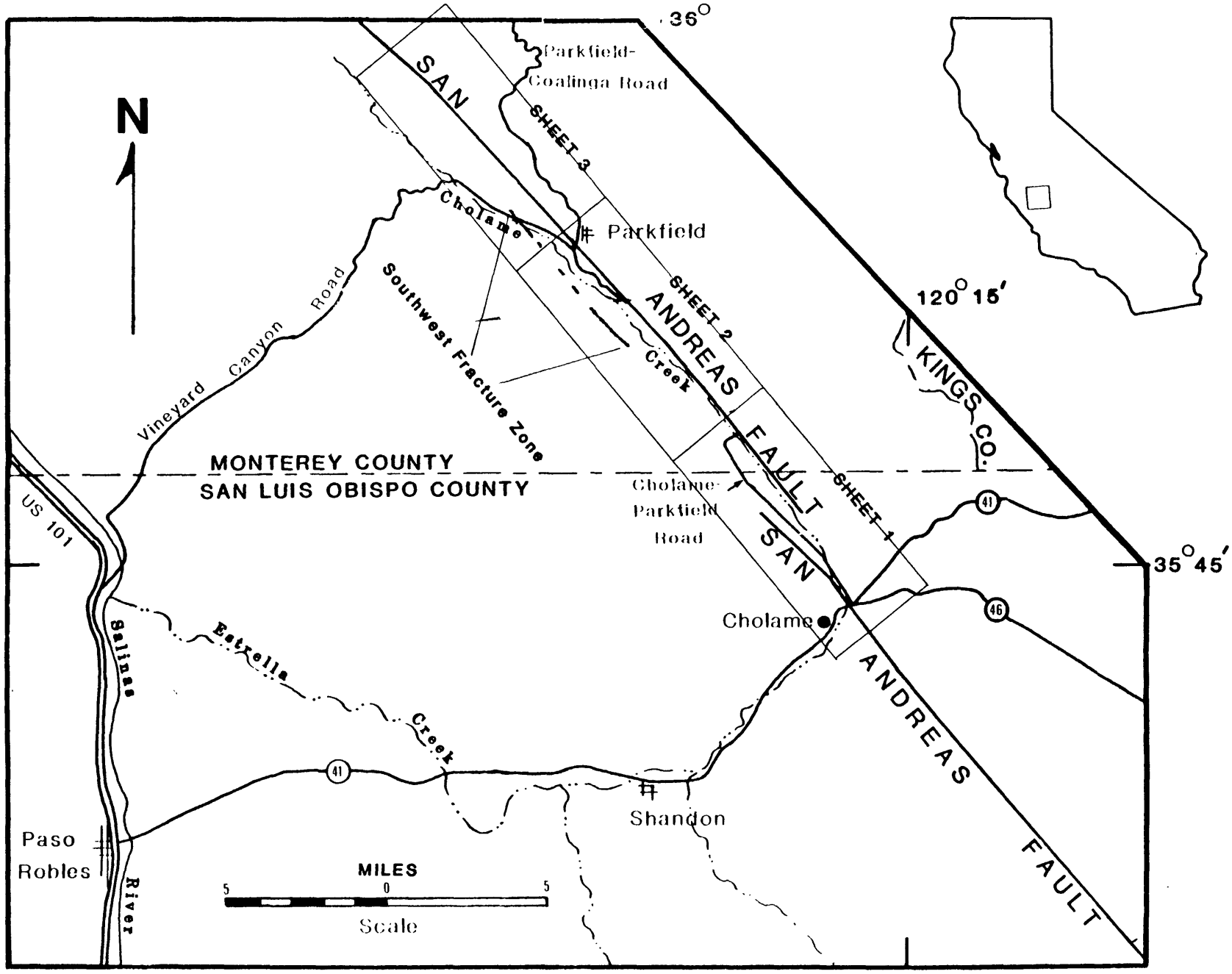

Figure 1 Location of map of faulting accompanying the 1966 Parkfield earthquake