

U.S. DEPARTMENT OF THE INTERIOR U.S. GEOLOGICAL SURVEY

Introduction We present photomosaics and logs of the walls of trenches excavated for a paleoseismic study at Arano Flat, one of two sites along the San Andreas fault in the Santa Cruz Mountains on the Kelley-Thompson Ranch (Figures 1, 2). At this location, the fault consists of a narrow zone along the northeast side of a low ridge adjacent to a possible sag pond and extends about 60-70 meters across a broad alluvial flat. This site was a part of Rancho Salsipuedes begining in 1834 and was purchased by the present owner's family in 1851.

Aethodology

We excavated 13 trenches perpendicular to the fault and 4 trenches parallel to the fault (Fig. 4) in order to resolve evidence for individual surface-rupturing earthquakes. Trench 1 was excavated during October 1995 and logged by J. Baldwin. Trench 2 was excavated and logged by G. Heingartner in November 1995 (Heingartner, 1998). Trench 1 was widened and Trenches 3 and 4 were excavated and logged by G. Heingartner in 1996. Heingartner also excavated a trench northwest of Trench 4 which exposed the fault in bedrock and two trenches with a total length of about 40 meters parallel to Trench 2 on the southwest side of Arano Creek which did not expose any faulting. None of these three trenches was logged. Trench 3 was widened and re-logged and Trenches 5-12 and Trench 14 were excavated and logged by T. Fumal amd L. Samrad during 1997-1999. Trench 13 was excavayted to confirm the location of the fault and was not logged. We also excavated a pit about 3 meters wide and 10 meters long in order to precisely measure offsets of a partially buried 19th century channel and a small 15th century fold. The water table is within 2 meters of the ground surface over the entire ste. For this reason we excavated Trenches 5A and 6A as deep V-shaped trenches that joined Arano Creek to facilitate drainage. Trenches 1-4 were logged using the traditional method of hand drawing linework on graph paper. Trenches 3 and 5-12 and 14 were photologged. For this technique, a 1m-by-0.5m nail and string grid was constructed on the trench walls and each 1m by 0.5m rectangle was photographed with a 35mm film camera fitted with a 20mm rectilinear lens. The camera was mounted on a "Trench-o-matic", a frame constructed of aluminum tubing that acts to keep the film plane parallel to and and equidistant from the trench wall for each photo (Fig. 5). Logging was done on mylar over prints of the photos. Later, the photos were digitized, rectified to the measured string and nail grid visible on each photo, and mosaiced together. Field linework was then transferred to the photomosaics. Detrital charcoal is abundant in each layer throughout the stratigraphic section. One hundred thirteen samples of detrital charcoal were dated using the AMS technique at Lawerence Livermore National Laboratory by G. Heingartner, J. Southon, and G. Seitz. We found evidence for nine earthquakes during the past 1000 years. The average recurrence interval it about 105 years. The most recent earthquake was the 1906 San Francisco earthquake. Faulting during this earthquake is poorly expressed in most exposures

except on the northwest wall of Trench 3 were it appears as a small sand-filled fissure.

NORTHEAST

NODTHEAST

Heingartner, G.F., 1998, Paleoseismic recurrence investigation of the Santa Cruz Mountains segment of the San Andreas fault near Watsonville, California: M.S. thesis, San Jose State University, San Jose, CA.



TRENCH 5 SOUTHEAST WALL

TRENCH 5 NORTHWEST WALL (reversed)

Figure 2. Perspective view of northern Monterey Bay area showing location of trench sites on the San Andreas fault.

ARANO FLAT RADIOCARBON AGES												
CAMS#	SAMPLE #	UNIT	C-14 AGE	CAMS#	SAMPLE #	UNIT	C-14AGE	CAI	MS#	SAMPLE #	UNIT	C-14AGE
26209	T1-95-18AN-10a	10	120 ± 60	33091	T1-96-14CS-22b	0 22	310 ± 50	500	073	5A-50	90 upper bottom	690 ± 50
26210	T1-95-7AS-10		150 ± 60	22888	T1-95-12BN-22/	A	330 ± 60	500	074	5A-51		800 ± 40
27953	T1-95-23BS-10A		180 ± 60	33095	T1-96-14CS-22a	1	350 ± 50	500	075	5A-52		780 ± 40
27957	T1-95-5AN-10		370 ± 60	22851	T1-95-12CS-22		420 ± 60					
				22852	T1-95-16CN-22a	a	500 ± 60					
26208	T1-95-13BS-17a	17	170 ± 50	31271	T3-96-3CN-22		510 ± 50					
26207	T1-95-16BN-17a		250 ± 60	31477	T3-96-3CN-22		700 ± 50	489	905	5A-14	90 middle	1340 ± 80
32188	T1-96-13BN-17A		370 ± 40	27246	T1-95-12CS-22		800 ± 50	489	921	5A-20		880 ± 50
27247	T1-95-13BS-17b		430 ± 60					500	048	5A-21		1060 ± 40
				31852	T3-96-6BN-22/2	25 22/25	170 ± 60	228	884	T1-95-7CS-10	00	950 ± 50
31848	T1-96-14BS-17/18	a 17/18	180 ± 60	31476	T3-96-4BS-22/2	5	270 ± 60	220	057	T1-95-10CS-1	100	1000 ± 60
31846	T1-96-13BN-17/18		190 ± 50	31266	T3-96-4BS-22/2	5	320 ± 60	489	916	5A-35		960 ± 40
31849	T1-96-14BS-17/18	b	270 ± 60	32184	T4-96-4BN-22/2	25B	360 ± 60	490	028	5A-36		970 ± 40
31847	T1-96-14BN-17/18		300 ± 50	31851	T3-96-4BS-22/2	5b	470 ± 60	489	903	5A-11		1010 ± 40
				31850	T3-96-3CS-22/2	5	490 ± 60					
31853	T1-96-14BS-18	18	80 ± 60					490	002	5A-12	90 lower	950 ± 40
32185	T3-96-15BN-18B		120 ± 60	22887	T1-95-11BN-25/	A 25	380 ± 60					
27951	T1-95-19CS-18A		220 ± 50	31267	T3-96-5BN-25		390 ± 60					
33089	T3-96-3BS-18		220 ± 50	22850	T1-95-10BS-25		410 ± 80	489	913	5A-2	100 upper	1070 ± 40
26213	T1-95-14BS-18b		230 ± 50	22853	T1-95-21DN-25a	а	560 ± 50	489	999	5A-3		1320 ± 50
32186	T3-96-4AS-18		280 ± 50	22059	T1-95-11CS-25		610 ± 60	490	003	5A-15		950 ± 40
33093	T1-96-15BN-18a		280 ± 50	33090	T3-96-5BN-25		630 ± 50	490	026	5A-30		1030 ± 40
27952	T1-95-13BS-18		290 ± 60	33094	T1-96-13DS-25		770 ± 40	228	854	T1-95-10DS-	100	1060 ± 60
31475	T1-96-4AS-18		310 ± 60	22058	T1-95-12CN-25		1110 ± 60	490	000	5A-6		1010 ± 40
33092	T1-96-13BS-18b		310 ± 60	27960	T1-95-9BS-25		2300 ± 80					
22856	T1-95-17BN-18a		340 ± 60	27958	T1-95-11CN-25		3120 ± 60	489	902	5A-7	100 upper	1000 ± 40
26238	T1-95-14BS-18A		380 ± 60					490	001	5A-8		1070 ± 40
27248	T1-95-18BN-18a		1220 ± 50	22062	T1-95-10CS -40	40	430 ± 80	490	024	5A-31		1250 ± 40
26241	T1-95-15BN-18A		2520 ± 70	22855	T1-95-9CN -40		480 ± 60	490	027	5A-34		1060 ± 50
				22061	T1-95-11CN -40		690 ± 60					
31854	T1-96-12BS-19b	19	50 ± 50					489	904	5A-13	100 lower	1650 ± 40
26211	T1-95-13BS-19b		100 ± 60					489	919	5A-9		4040 ± 40
31855	T1-96-12BS-19a		130 ± 50	22885	11-95-11CS-500	; 50	160 ± 60					
22889	T1-95-14BS-19A		130 ± 60	22050	11-95-11CS-50		910 ± 60	489	906	5A-16	120 upper	2080 ± 50
22056	T1-95-12BS-19		150 ± 60	49029	5A-37		370 ± 40	489	920	5A-18		1230 ± 60
31269	T3-96-3BS-19a		150 ± 60	48917	5A-38		490 ± 40					
23212	T1-95-14BN-19a		160 ± 60	49030	5A-39		480 ± 50	489	908	5A-32	120 lower	1240 ± 40
31270	T3-96-5BS-19		160 ± 60	49031	5A-40		670 ± 40	489	915	5A-33		1410 ± 30
32182	T4-96-5BN-19A		170 ± 60	48909	5A-41		1380 ± 40	489	907	5A-17		610 ± 40
31856	T1-95-22BN-19a		180 ± 50	49025	5A-42		580 ± 40	489	914	5A-19		1800 ± 40
32187	T3-96-2BN-19A		200 ± 60	40040	FA 40		040 / 40					
26239	T1-95-13BN-19		210 ± 60	48910	5A-43 90	upper top	640 ± 40					
32183	14-96-5BN-19B		350 ± 60	48998	5A-44		600 ± 40					
27959	T1-95-20CN-19A		460 ± 60	48911	5A-45		650 ± 40					
26242	11-95-17BS-19A		1870 ± 60	48912	5A-40		000 ± 40					
27955	11-95-18BN-19A		2500 ± 60	48918	5A-47		1020 ± 60					
27956	11-95-21CN-19A		3450 ± 70									







PHOTOMOSAICS AND LOGS OF TRENCHES ON THE SAN ANDREAS FAULT AT ARANO FLAT NEAR WATSONVILLE, CALIFORNIA

Thomas E. Fumal, Gordon F. Heingartner, Laura Samrad, Timothy E. Dawson, John C. Hamilton and John N. Baldwin 2003

IIT	DESCRIPTION	EARTHQUAKE HORIZON
0	v dk grey 10YR 3/1 clay loam to sandy clay loam up to 10-15% fine gravel heavily bioturbated	— 1906
7	dk yellowish brown 10YR 3/6 moderately well-sorted fine sand with some fine gravel to fine gravelly sand	
8	dk greyish brown 10YR 4/2 fine sandy clay loam some fine gravel	
9	top of unit unusually charcoal-rich w/ dusky red mottles -possible insi v dk grey 10YR 3/1 silty clay	tu burn
22	dk yellowish brown 10YR 3/6 moderately well-sorted fine sand some fine gravel	AF-3
25	top of unit unusually charcoal-rich -possible insitu burn dk greyish brown 10YR 4/2 fine sandy clay w/ lenses of sand and gravelly sand	АГ-4
.0	grey 2.5Y 5/1 mottled dk yellowish brown 10 moderately well-sorted fine-med sand some manganese(?) nodules	YR 4/6 AF-5
i0	v dk greyish brown silty clay	AF-6
5	moderately well-sorted vf to med sand grey brown 2.5Y 5/2 to grey 2.5Y 5/1 mottled yellowish brown 10YR 5/6 to strong brown 7 with thin clay bed v dk grey N3/	i .5YR 4/6
0	v dk grey N3/ clay with dk reddish brown hard nodules v dk grey 10YR 3/1 silty clay	AF-7 AF-8
	moderately well-sorted vf to med sand v dk greyish brown 10YR 3/2	AF-9
00	v fine sandy clay loam sandy gravel gravelly sand moderately well-sorte	d vf to med sand
	v dk grey 10YR 3/1 sandy clay	N FAU
10	gravelly sand	OSED II
20	v dk grey 10YR 3/1 silty clay vf sandy clay loam	NOT EXP
eath edro	brown 7.5YR sandy clay loam 1ered Ck brown 7.5YR sandy clay loam matrix w/ and	zular clasts
	of brownish yellow 10YR 6/6 mudstone and	fine sandstone



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