Table DR1. Radiocarbon data arranged in stratigraphic order (see Fig DR2 and Toke et al., 2006). Pretreatment and analyses were performed by either the NSF-Arizona AMS facility at the University of Arizona (AA-#) or the KECK University of California Irvine AMS Facility (UCI-#). These facilities use the background correction of Stuiver and Polach, (1977).

Sample ID[1]	NSF-AMS#	Sample Description	Stratigraphic Unit[2]	Fraction Modern	+/- [3]	^{14}C age (years BP)	+/-[4]	2σ calibrated age (cal A.D. / B.C.)[5]	Modeled and Trimmed 2σ calibrated age (cal A.D. / B.C.)[6]
(2) 04MST-33	AA-61393 UCI-49998	charcoal	between MSW-103 and MSW-104 (laminated silt/clay)	0.7044 0.7548	0.0033 0.0011	2815 (detrital) 2260	37 15	400-350 B.C. (53.4 %) 290-230 B.C. (42.0%)	400-350 B.C. (53.4 %) 290-230 B.C. (42.0%)
(2) 04MST-9	AA-61386 UCI-49993	charcoal	between MSE-101 and MSE-102 (laminated Silt/clay)	0.7563 0.7544	0.0034 0.0011	2243 2265	36 15	400-350 B.C. (57.5%) 290-230 B.C. (37.9%)	400-350 B.C. (57.5%) 290-230 B.C. (37.9%)
07MST-P1	*UCI-49992*	*charcoal piece*	*MSE-103 (massive clayey silt)*	*0.7445*	*0.0010*	*2370*	*15*	*510-430 B.C. (23.8%) 420-390 B.C. (71.6%)*	*Detrital*
04MST-6	*UCI-49552*	*charcoal*	*MSE-103 (massive clayey silt)*	*0.7438*	*0.0015*	*2375*	*20*	*520-390 B.C.*	*Detrital*
04MST-18	UCI-49994	charcoal	lower charcoal stringer within MSE-108 (dark clay)	0.8790	0.0028	1035	30	890-920 A.D. (5.6%) 940-1040 A.D. (89.8%)	890-920 A.D. (6.7%) 940-1040 A.D. (88.7%)
04MST-17	*AA-61387*	*charcoal*	*MSE-110 (buried organic horizon)*	*0.8508*	*0.0037*	*1298*	*35*	*650-780 A.D.*	*Detrital*
04MST-26	*AA-61390*	*charcoal*	*MSE-110 (clayey silt)*	*0.7867*	*0.0035*	*1927*	*36*	*20-10 B.C. (1.0%) 0-140 A.D. (90.1%) 150-180 A.D. (2.3%) 190-220 A.D. (2.0%)*	*Detrital*
04MST-27	UCI-49996	charcoal	between MSE-111 and MSE-112 (clayey silt)	0.9430	0.0025	470	25	1410-1450 A.D.	1410-1450 A.D.
04MST-21	*UCI-49566*	*charcoal*	*MSE-112 (silty clay)*	*0.8663*	*0.0038*	*1155*	*40*	*770-980 A.D.*	*Detrital*
07MST-9	*UCI-49565*	*charcoal*	*MSE-112 (silty clay)*	*0.9186*	*0.0072*	*680*	*70*	*1220-1410 A.D.*	*Detrital*
04MST-22	*AA-61388*	*charcoal*	*MSE-112 (silty clay)*	*0.9221*	*0.004*	*652*	*35*	*1270-1330 A.D. (44.7%) 1340-1400 A.D. (50.7%)*	*Detrital*
04MST-3	UCI-49551	charcoal	MSE-112 (silty clay)	0.9493	0.0019	420	20	1430-1490 A.D.	1430-1460 A.D.
04MST-24	*AA-61389*	*charcoal*	*MSE-114 (laminated silt)*	*0.8311*	*0.0056*	*1486*	*55*	*1160-1300 A.D.*	*Detrital*
04MST-25	UCI-49554	charcoal	between MSE-114 and MSE-115 (laminated silt)	0.9485	0.0021	425	20	1430-1485 A.D.	1440-1470 A.D.
04MST-28	*UCI-49555*	*charcoal*	*top of MSE-115 (laminated silt/clay)*	*0.9287*	*0.0019*	*595*	*20*	*1300-1370 A.D. (72.2%) 1380-1410 A.D. (23.2%)*	*Detrital*
04MST-29	UCI-49997	charcoal	within MSE-115 (silty sand)	0.9488	0.0016	420	15	1435-1480 A.D.	1440-1480 A.D.
07MST-8	UCI-49564	charcoal	between MSE-117 and MSE-118 (silty sand)	0.9486	0.040	425	35	1410-1530 A.D. (86.2%) 1590-1620 A.D. (9.2%)	1440-1530 A.D. (91.0%) 1590-1620 A.D. (4.4%)
04MST-16	UCI-49553	charcoal piece	MSW-106 (clayey sand)	0.9545	0.0019	375	20	1440-1530 A.D. (67.6%) 1570-1630 A.D. (27.8%)	1440-1530 A.D. (67.6%) 1570-1630 A.D. (27.8%)
04MST-32	*AA61392*	*charcoal*	*MSE-118 (sandy clay)*	*0.7833*	*0.0049*	*1961*	*51*	*100 B.C.-140 A.D.*	*Detrital*
04MST-30	*AA61391*	*charcoal*	*MSE-119 (silty clay)*	*0.9558*	*0.0041*	*363*	*34*	*1440-1640 A.D.*	*Detrital*
04MST-31	UCI-49556	charcoal	MSE-119 (silty clay)	0.9761	0.0020	195	20	1650-1690 A.D. (22.2%) 1730-1810 A.D. (53.3%) 1930-1960 A.D. (20.9%)	1650-1690 A.D. (22.3%) 1730-1810 A.D. (52.3%) 1930-1960 A.D. (20.8%)

(1) Assigned sample name based upon: A) the year collected, B) the trench of collection, and C) the order of collection
(2) Stratigraphic unit: Trench name, east or west stratigraphy, higher numbers are younger layers. 2004 and 2007 units are correlative here, but different names were used in Toke et al., 2006. Here MSE-119 is equivalent to MSE-24 in 2004; MSW-106 here is equivalent to MSW-7 in 2004; MSE 5 from 2004 is subdivided to MSE 105-107; MSE 8 from 2004 is equivalent to MSE 109-110 here. For further explanation see figure D1 and Toke et al., 2006.
(3) Error value (2σ) assessed in the calculation of the modern fraction.
(4) Error value (2σ) assessed in the calculation of ^{14}C years before present.
(5) Determined using single samples in OxCal 3.10 (Bronk Ramsey, 1995; 2001; and 2005) and using the atmospheric data of Reimer et al., (2004).
(6) Same as (5), but sequenced, modeled, and trimmed in OxCal v3.10 after *removal of detrital samples*.

Table DR2. Radiocarbon data, PT paleoseismic trenches. Arranged by relative stratigraphic age (see Fig. DR3 and Toke et al., 2006). Pretreatment and analyses were performed by either the NSF-Arizona AMS facility at the University of Arizona (AA-#) or the KECK University of California Irvine AMS Facility (UCI-#). These facilities use the background correction of Stuiver and Polach, (1977).

Sample ID[1]	NSF-AMS#	Sample Description	Stratigraphic Unit[2]	Fraction Modern	+/- [3]	^{14}C age (years BP)	+/-[4]	2σ calibrated age (cal A.D. / B.C.)[5]	Modeled and Trimmed 2σ calibrated age (cal A.D. / B.C.)[6]
07PT-SE14	UCI- 49563	charcoal	PTE-033 (thin laminated silt/clay)	0.6498	0.0013	3460	20	1880-1730 B.C (87.6%) 1720-1690 B.C. (7.8%)	1880-1730 B.C. (87.7%) 1720-1690 B.C. (7.7%)
04PT-7	*AA-61382*	*charcoal*	*PTE-037 (thin laminated silt/clay)*	*0.6018*	*0.0029*	*4079*	*39*	*2870-2800 B.C. (16.3%) 2760-2480 B.C (79.1%)*	*Detrital*
(2) 07PT-NW9	UCI-49991 UCI-49560	charcoal	PTE-040 (clayey sand)	0.6884 0.6891	0.0009 0.0016	3000 2990	15 20	1310-1190 B.C. (91.2%) 1180-1160 B.C (1.5%) 1150-1130 B.C. (2.7%)	1320-1190 B.C. (92.3%) 1180-1160 B.C. (1.1%) 1150-1130 B.C. (2.0%)
04PT-3	*AA-61381*	*charcoal single piece*	*PTE-042 (thin laminated silt/clay)*	*0.6677*	*0.0033*	*3244*	*40*	*1620-1430 B.C.*	*Detrital*
(2) 04PT-8	*AA-61383 UCI-49990*	*charcoal single piece*	*PTE-043 (clayey silt)*	*0.6993 0.6940*	*0.0032 0.0009*	*2873 2935*	*37 15*	*1210-1040 B.C.*	*Detrital*
07PT-NW2	*UCI-49558*	*charcoal*	*PTE-043 (light grey silt/clay)*	*0.7007*	*0.0016*	*2855*	*20*	*1120-970 B.C. (86.5%) 960-930 B.C. (8.9%)*	*Detrital*
04PT-1	UCI-49989	charcoal	PTE-043 (clayey silt)	0.7299	0.0012	2530	15	800-530 B.C	810-660 B.C.
07PT-NW-1	UCI-49557	charcoal	PTE-047 (near boundary with sandy unit and C-horizon)	0.7293	0.0017	2535	20	800-740 B.C. (41.0%) 690-660 B.C (22.0%) 650-550 B.C. (32.4%)	780-740 B.C. (5.2%) 690-660 B.C. (40.5%) 650-560 B.C. (49.8%)
07PT-NW-4	UCI-49559	charcoal	PTE-048g (light grey clay)	0.7297	0.0015	2530	20	790-740 B.C. (34.5%) 690-660 B.C. (21.7%) 650-540 B.C. (39.2 %)	690-660 B.C. (8.8%) 650-540 B.C. (86.6%)
07PT-SE12	UCI-49562	charcoal	PTFZ-010 (dark clay in FZ)	0.8475	0.0017	1330	20	650-710 A.D. (85.7%) 740-770 A.D. (9.7%)	650-710 A.D. (87.4%) 740-770 A.D. (8.0%)
07PT-NW16	UCI-49561	charcoal	PTW-096 (clayey sand)	0.8465	0.0019	1340	20	640-700 A.D. (91.5%) 750-770 A.D. (3.9%)	640-700 A.D. (91.5%) 750-770 A.D. (3.9%)
04PT-13	AA-61384	Charcoal	PTFZ-005 (thin layer of leaf and other organic matter)	0.916	0.0039	705	35	1250-1320 A.D. (74.1%) 1350-1390 A.D. (21.3%)	1250-1320 A.D. (71.5%) 1350-1390 A.D. (23.9%)

(7) Assigned sample number based upon: A) the year collected, B) the trench of collection, and C) the order of collection.
(8) Stratigraphic unit: Trench name, east or west stratigraphy, higher numbers are younger layers. Units are correlative between 2007 and 2004 trenches however the unit names have been changed: Here PTW-096 is equivalent to PTW 5; PTE-039 is correlative to PTE 11; and PTE-048 is correlative to PTE 1.
(9) Error value (2σ) assessed in the calculation of the modern fraction.
(10) Error value (2σ) assessed in the calculation of ^{14}C years before present.
(11) Determined using single samples in OxCal v3.10 using the atmospheric data of Stuiver et al., (1998).
(12) Same as (5), but sequenced, trimmed, and modeled in OxCal v3.10 without clearly detrital samples.

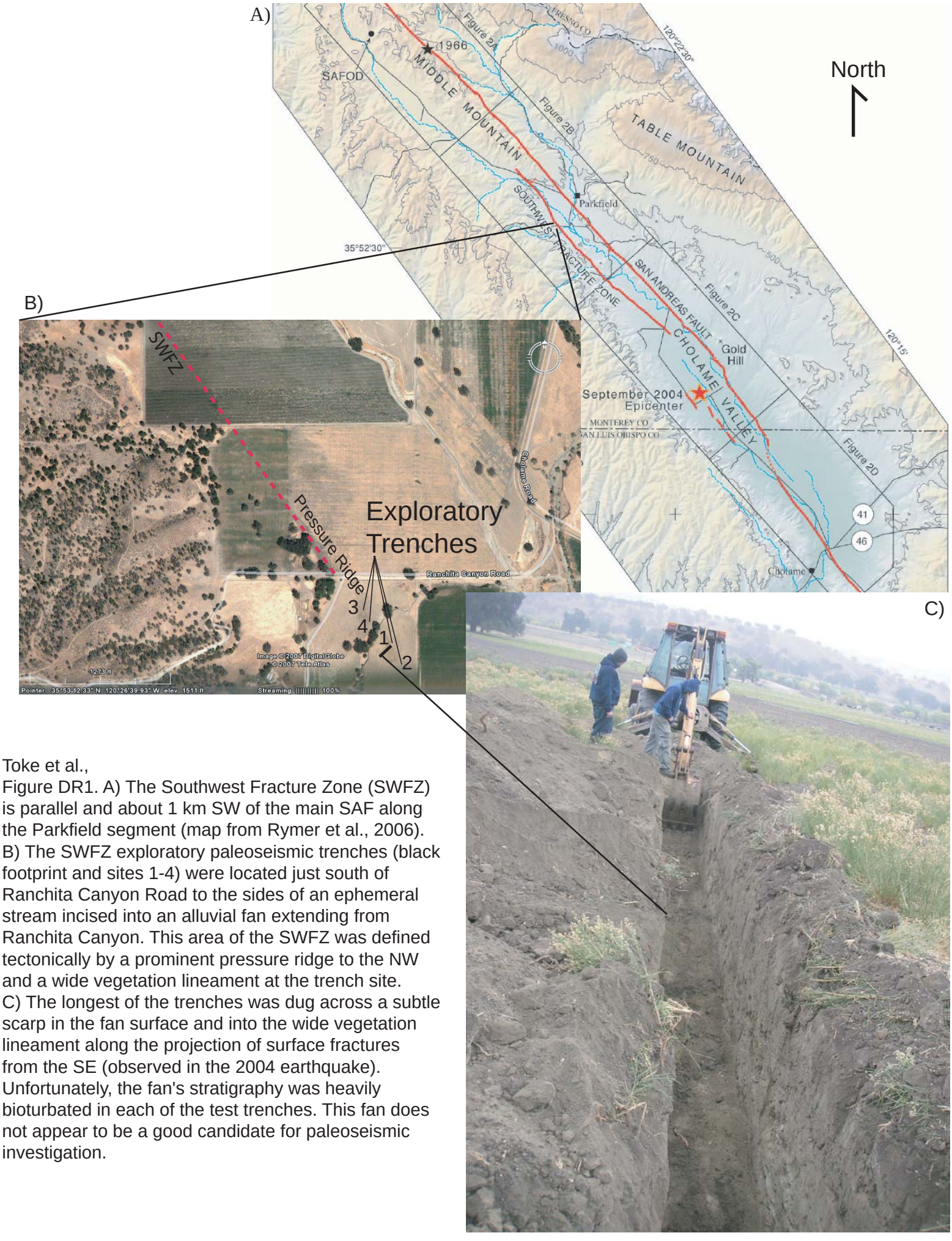
Table DR3. Slip Rate Calculations

Measurement	Mean	Mode	Median	Bounds
Gaussian Age and Displacement PDF Combinations*				
1-Sigma†				
Displacement (m)	20.75	20.75	20.75	+0.77 / -0.77
Age of displacement (ka)	0.79	0.79	0.79	+0.08 / -0.08
Slip rate (mm/year)	26.4	25.7	**26.2**	**+3.0 / -2.5**
2-Sigma†				
Displacement (m)	20.75	20.74	20.76	+2.15 / -2.15
Age of displacement (ka)	0.84	0.84	0.84	+0.27 / -0.27
Slip rate (mm/year)	25.4	23.6	**24.8**	**+11.9/ -6.4**
Box Car Age and Displacement PDF combinations				
1-Sigma†				
Displacement (m)	20.75	18.5	20.75	+1.54 / -1.54
Age of displacement (ka)	0.79	0.56	0.79	+0.16 / -0.16
Slip rate (mm/a)	26.9	22.5	**26.2**	**+6.4 / -4.4**
2-Sigma†				
Displacement (m)	20.75	18.5	20.75	+2.15 / -2.15
Age of displacement (ka)	0.84	0.56	0.84	+0.27 / -0.27
Slip rate (mm/year)	25.8	20.6	**24.8**	**+12.6 / -6.9**
Mixed Gaussian (Displacement) and Box Car (Age) PDF Combinations				
1-Sigma†				
Displacement (m)	20.75	20.75	20.75	+0.77 / -0.77
Age of displacement (ka)	0.79	0.56	0.79	+0.16 / -0.16
Slip rate (mm/a)	26.9	21.8	**26.2**	**+6.4 / -4.3**
2-Sigma†				
Displacement (m)	20.75	20.74	20.76	+2.15 / -2.15
Age of displacement (ka)	0.84	0.56	0.84	+0.27 / -0.27
Slip rate (mm/year)	25.7	20.3	**24.8**	**+12.2 / -6.6**
Mixed Gaussian (Age) and Box Car (Displacement) PDF Combinations				
1-Sigma†				
Displacement (m)	20.75	18.5	20.75	+1.54 / -1.54
Age of displacement (ka)	0.79	0.79	0.79	+0.08 / -0.08
Slip rate (mm/year)	26.4	25.7	**26.2**	**+3.3 / -2.8**
2-Sigma†				
Displacement (m)	20.75	18.5	20.75	+2.15 / -2.15
Age of displacement (ka)	0.84	0.84	0.84	+0.27 / -0.27
Slip rate (mm/year)	25.5	23.7	**24.8**	**+12.0 / -6.6**

Note: Calculations were made using the slip rate software package of Zechar and Frankel, 2009. For visualization see Fig. DR5 and Fig. 4.

* Probability Density Functions

† The 1 and 2 sigma values (mean, mode, median) for age of offset depend upon the corresponding radiocarbon range (Table DR1).

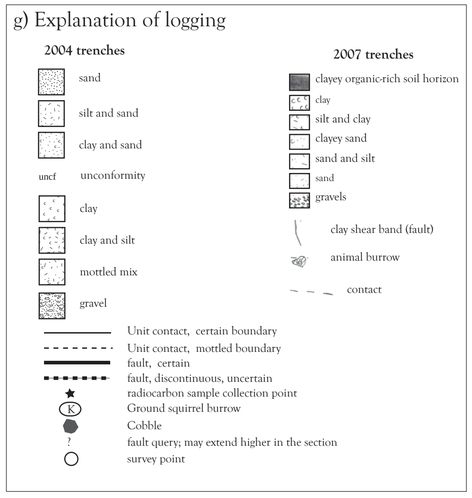


Toke et al.,
Figure DR1. A) The Southwest Fracture Zone (SWFZ) is parallel and about 1 km SW of the main SAF along the Parkfield segment (map from Rymer et al., 2006). B) The SWFZ exploratory paleoseismic trenches (black footprint and sites 1-4) were located just south of Ranchita Canyon Road to the sides of an ephemeral stream incised into an alluvial fan extending from Ranchita Canyon. This area of the SWFZ was defined tectonically by a prominent pressure ridge to the NW and a wide vegetation lineament at the trench site. C) The longest of the trenches was dug across a subtle scarp in the fan surface and into the wide vegetation lineament along the projection of surface fractures from the SE (observed in the 2004 earthquake). Unfortunately, the fan's stratigraphy was heavily bioturbated in each of the test trenches. This fan does not appear to be a good candidate for paleoseismic investigation.

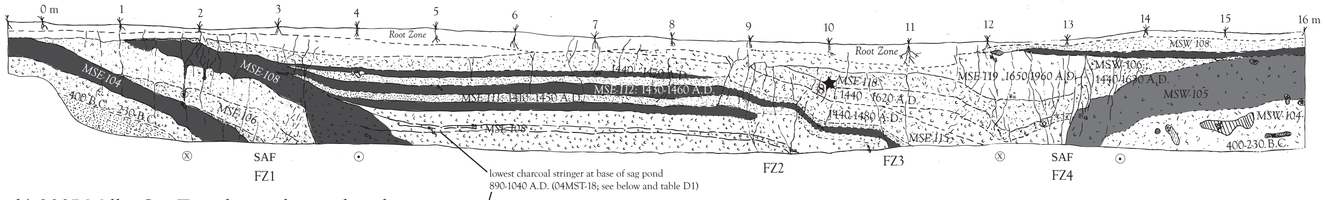
NE

SW

g) Explanation of logging

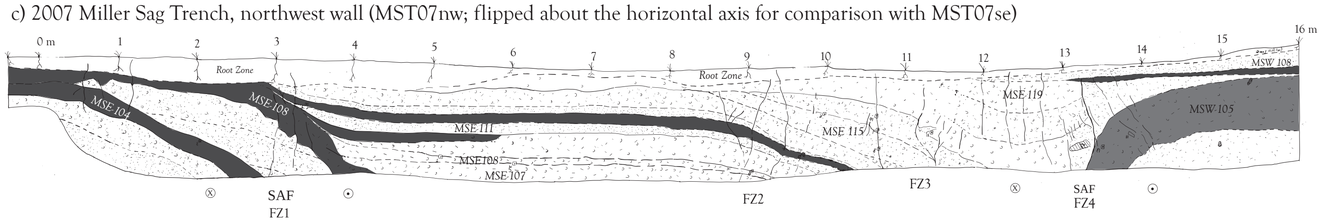


a) 2007 Miller Sag Trench, southeast wall (MST07se)

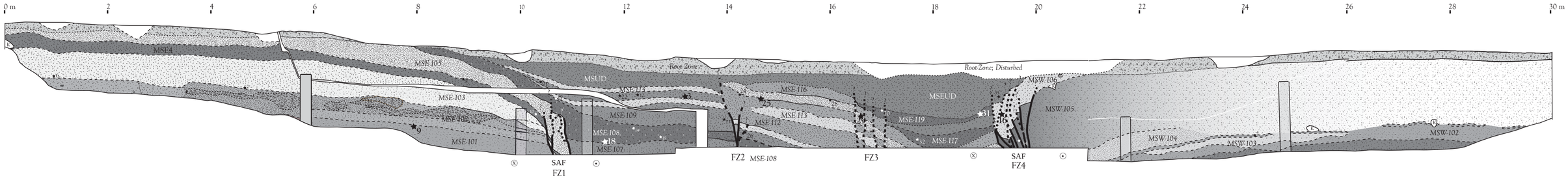


b) 2007 Miller Sag Trench, southeast photolog mosaic

c) 2007 Miller Sag Trench, northwest wall (MST07nw; flipped about the horizontal axis for comparison with MST07se)

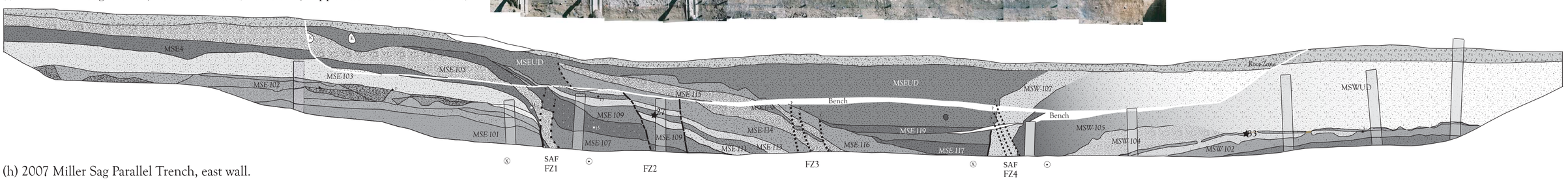


(d) 2004 Miller Sag Trench, southeast wall (MST04se).



e) 2004 Miller Sag Trench, southeast photolog mosaic

(f) 2004 Miller Sag Trench, northwest wall (MST04nw; flipped about horizontal axis).



(h) 2007 Miller Sag Parallel Trench, east wall.

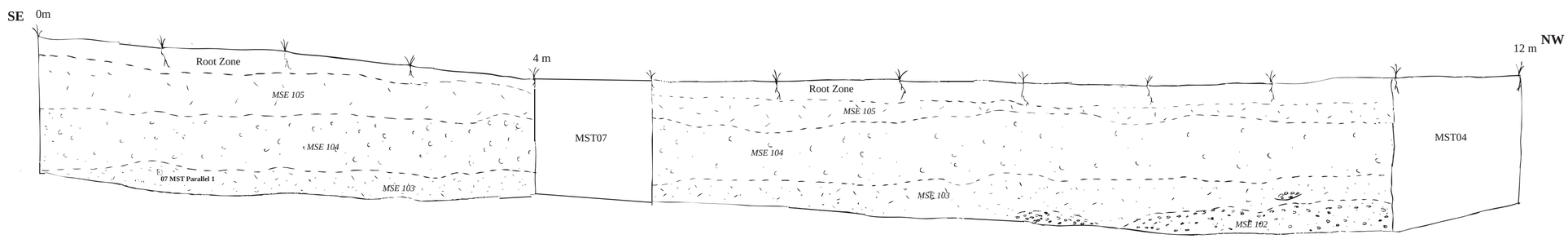


Figure DR2. The fault-perpendicular 2007 Miller Sag Trenches (a-c) exposed the same stratigraphic sequence as the 2004 MST trenches (d-f; Toke et al., 2006). However, the 2007 trenches revealed the continuity of the stratigraphy across fault zone 2 (FZ2) and provided additional radiocarbon samples. Here we plot a summary of the 2-sigma trimmed age ranges interpreted from all MST trenches (2004 and 2007) on the MST07se trench log within the corresponding unit. For detailed age ranges see Table D1. The MST07se and MST04se photologs (a and b, respectively) provide a visual reference the logging interpretations (b). Note the obliquity of the fault surfaces exposed between FZ3 and FZ4 in the photologs (see Figure DR4 as well). The MSTnw trenches (c and f) were drawn with considerably less deformation interpretation because it was difficult to discern the clay shear bands on the sun facing side of the trench. Stratigraphy consisted of a variety of terrace deposits and reworked sag material (g). For a detailed explanation of individual units see the text, and Toke et al., 2006. MST07parallel (h) exposed the tabular beds of overbank terrace deposits. The stratigraphy in the parallel trench exposes units MSE 102 - MSE 105.

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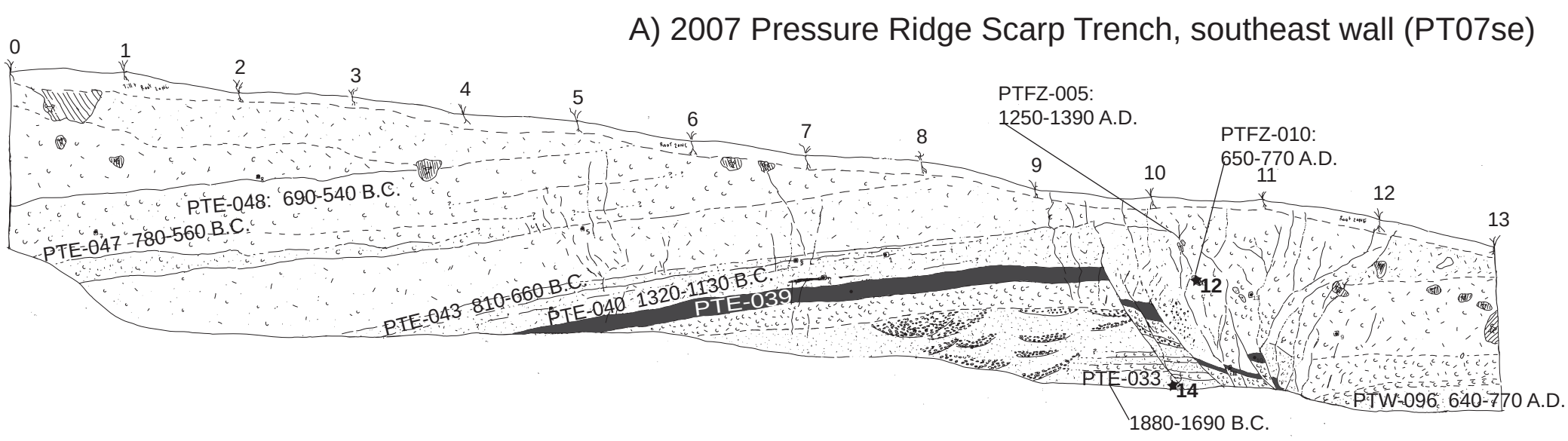
Figure DR3. Pressure Ridge Trenches (PT). Trench logs for the southeast (A; PT07se) and northwest (B; PT07nw) walls of the 2007 field season reveal the same stratigraphic sequence as the 2004 field season (C; PT04nw); for locations see Fig. 2. The stratigraphy displays oblique right-lateral deformation of fluvial overbank deposits and buried soil horizons (PTE-039). Units and deformation features are consistent between the 2004 and 2007 PT trenches, however here we have renamed the units. Please refer to Toke et al., 2006 to compare the unit naming changes and detailed descriptions of the units. Radiocarbon analyses are presented in Table DR2. On panel A we provide the eight unit ages (those determined not to contain a significant detrital signal) amalgamated from both the 2004 and 2007 PT radiocarbon analyses. Non-detrital radiocarbon sample locations are denoted by bold black stars and numbering. Samples that have not contributed to the age chronology are denoted by smaller stars and numbering. SAF deformation along the pressure ridge is localized to one fault zone. This fault zone doubles in width in the upper 2m of the soil column and displays oblique clary shear bands (Fig. DR4) as well as significant oblique right-lateral offset; juxtaposing many different thicknesses of unit PTE-039.



D) Explanation of logging

2007 Trenches

- clayey organic-rich soil horizon
- clay
- silt and clay
- clayey sand
- sand and silt
- sand
- gravels
- clay shear band (fault)
- animal burrow
- contact

2004 Trench

- clay
- clay and silt
- mottled mix
- gravel
- sand
- silt and sand
- clay and sand
- uncf — unconformity
- Unit contact, certain boundary
- Unit contact, mottled boundary
- fault, certain
- fault, discontinuous, uncertain
- radiocarbon sample collection point
- K — Ground squirrel burrow
- Cobble
- ? — fault query; may extend higher in the section
- survey point

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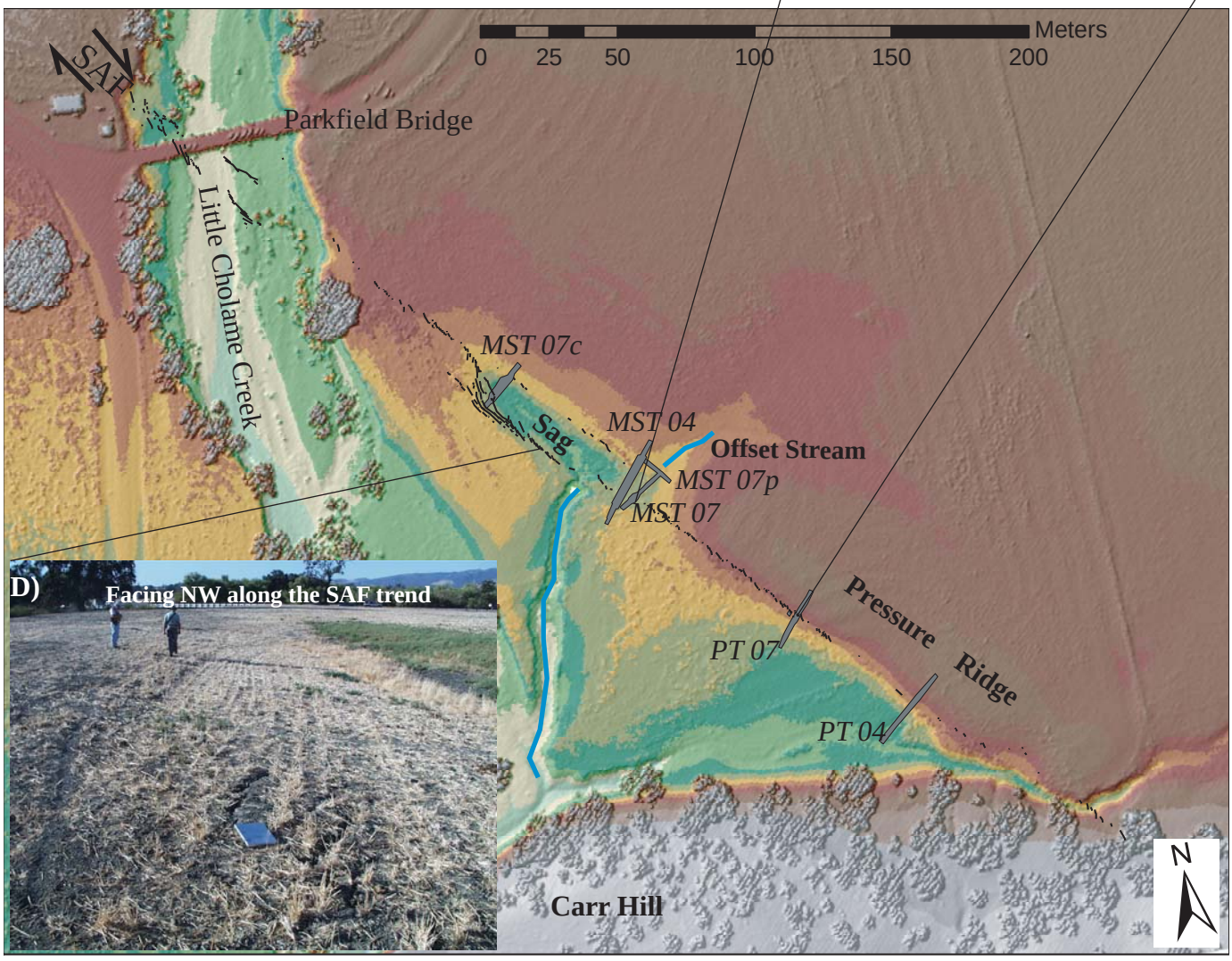
Figure DR4. Multiple clay shear band oblique deformation structures exposed in (A) MST07 and (B) PT07. (C) The 2004 Parkfield earthquake ruptured the surface as left stepping oblique en echelon opening mode surface fractures that grew via post-seismic afterslip (black fracture lines in C). A photo (D) of these surface cracks along the south side of the sag pond step-over with a field clip board for scale. We interpret that the oblique fault zone structures exposed within these paleoseismic trenches are a legacy of many moderate magnitude surface ruptures and aseismic creep.

A) MST07 SE trench wall, FZ 4

B) PT07 SE trench wall

C)



D)

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