

Annual Report: Precise dating earthquakes on the Elsinore fault at Glen Ivy Marsh based on archived radiocarbon samples, and publication of the results. SCEC Award # 25210

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We proposed to redate the Glen Ivy Marsh section with archived bulk samples recovered during past field work (Rockwell, 2017). The purpose was to provide better age control for the seven interpreted faulting events in preparation for formal publication of the site, and to support a proposal to extend and densely date the stratigraphic sequence to more tightly constrain event ages. The bulk samples were picked under a microscope for seeds, twigs, insect remains and charcoal, and from this collection of samples, 40 were submitted for radiocarbon analysis. As expected, a few of the original bulk dates yield ages are significantly younger than new dates on charcoal, probably due to the presence of roots, which were found during sample preparation. In contrast, some original bulk dates are older than new charcoal dates from the same unit, probably due to incorporation of old charcoal. Several charcoal dates are older than dates from underlying units indicating that they exhibit age inheritance (old wood problem; Erlandson and Rockwell, 1987). Finally, some seeds and/or seed husks were found to be a little older than some of the dates on charcoal from the same unit, which suggests reworking of seeds or seeds that penetrated downward by bioturbation or gravity. That said, the new dates combined with the old ones provide a robust chronology for the dating of past surface ruptures on the northern Elsinore fault.

Table 1 includes all radiocarbon dates from the Glen Ivy Marsh paleoseismic site. The dates outlined in light green exhibit minimal stratigraphic conflicts in age and are analyzed in OxCal 4.4.4 (Bronk-Ransey, 2021). Figure 1 shows the OxCal model output with the probability distributions of the interpreted event ages outlined in yellow. The event (E) ages are in calendar years: E1 – 1910, E2 – 1626-1813 CE, E3 – 1475-1729 CE, E4 – 1280-1436 CE, E5 – 1200-1273 CE, E6 – 924-995 CE, and E7 – 765-921 CE yielding an average recurrence interval of 170 years with a bimodal distribution of the length of intervals between events.

These results are being written up for submission to the Bulletin of the Seismological Society of America, planned to be submitted shortly.

References

- Bronk Ramsey, C. (1995). Radiocarbon calibration and analysis of stratigraphy: the OxCal program. *Radiocarbon* 37, 425e430. <https://doi.org/10.1017/S0033822200030903>.
- Bronk-Ramsey, C. (2021). <https://c14.arch.ox.ac.uk/oxcal/OxCal.html>
- Erlandson, J. & T.K. Rockwell (1987). Radiocarbon reversals and stratigraphic discontinuities: The effects of natural formation processes on coastal California archeological sites: in *Natural Formation Processes and the Archeological Record*: D.T Nash and M.D. Petraglia (eds), BAR International Series 352, p. 51-73.
- Rockwell, T.K. (2017). Paleoseismology of the northern Elsinore fault in southern California. Conference Proceedings for the 8th International INQUA Meeting on Paleoseismology, Active Tectonics and Archeoseismology (PATA), 13 – 16 November, 2017, New Zealand, 4 p.

Glen Ivy Sample and Date Compilation

"Peat" number	SDSU Lab Designation	Dating Lab Number	Material Dated	C14 age	uncertainty	C13
Event 1 - 1910						
Event 2 - Could be subsidence solely from groundwater withdrawal based on						
P2	P2	A4029		220	80	
P3	RC-003	QL4306	bulk peat	358	20	
P3b	RC-003	A4400	charcoal	490	90	-26.5
P3a	RC-003	310626	Charcoal	95	15	
P3	RC-003	310627	charcoal	modern		
Event 3						
P4a	RC-019	QL4307	bulk peat	407	34	
P4b	RC-019	A4374		590	90	-26.1
P4c	RC-019	310628	charcoal	935	15	
P4f	RC-019	310629	charcoal	620	40	
P4g	RC-019	310630	charcoal	660	15	
P5a	RC-192	310631	charcoal	625	15	
P5d	RC-192	310632	seeds	1090	15	
P6c	RC-015	310633	rass blades/ seed husk	670	15	
P7	RC-007	A4401		380	150	-25.7
P7b	RC-007	310634	Charcoal	2895	45	
Event 4						
P8a	RC-176	QL4308		717	21	
P8b	RC-176	A4375		820	90	-26.2
P8c	RC-176	A4034		730	100	
P8d	RC-176	310635	charcoal	570	15	
P8g	RC-176	310636	charcoal	750	15	
P8h	RC-176	310637	charcoal	660	15	
P9	P9	QL4309		688	20	
Event 5						
P10a	RC-182	QL4310		816	34	
P10b	RC-182	A4370		630	100	-25.9
P11a	RC-076	A4369		780	120	-26.2
P11b	RC-076	A4033		760	50	
P12	P12	QL4311		889	21	
P12d	P12	310638	charcoal	795	15	
P12e	P12	310639	charcoal	795	15	
P12f	P12	310640	charcoal	815	15	
P12g	P12	310641	charcoal	820	20	
P15	RC-101	A4376		1020	80	-27.3
P15b	RC-101	310642	charcoal	820	25	
P15d	RC-101	310646	charcoal	890	20	
P15k	RC-101	310648	seed casing?	1415	45	
P15m	RC-101	310647	bug parts	modern		
P20a	RC-163	QL4312		931	15	
P20b	RC-163	A4377		910	60	-26.8
P20c	RC-163	310649	charcoal	995	20	
P20c	RC-163	310649	charcoal	995	20	
P20d	RC-163	310650	charcoal	960	15	
P20g	RC-163	310651	charcoal	970	15	
P20h	RC-163	310652	charcoal	955	20	
P20k	RC-163	310653	seeds fragments	1080	20	
Event 6						
P22a	RC-108	QL4351		1076	16	
P22b	RC-108	A4378		1010	70	-26.5
P24	P24	QL4350		1141	15	
P26	P26	QL4315		1069	15	
P26b	P26	310654	charcoal	1110	20	
P26c	P26	310655	charcoal	1095	20	
P26d	P26	310656	charcoal	960	15	
P26g	P26	310657	charcoal	1125	15	
P26m	P26	310658	seed husks	1050	20	
Event 7						
P27b	P27	310659	charcoal	1130	20	
P27e	P27	310660	charcoal	1115	20	
P27f	P27	310661	charcoal	1135	15	
P27m	P27	310662	hard seeds	1170	15	
P27n	P27	310663	seed pods	1085	20	
P28/29	P28/29	QL4352		1216	23	
P28/29a	P28/29	310664	seed fragments	1155	15	
Unit A	RC239	A4372		5130	110	-26.4
Unit B	RC212	A4373		9040	160	-27.3
Unit C	RC218	A4371		10190	350	-27.5

Table 1. Radiocarbon dates from Glen Ivy Marsh. QL dates are from the University of Washington C14 facility, A dates are from the University of Arizona C14 facility, and the others are new dates from UCI CAMS facility. Dates outlined in green were run in OxCal.

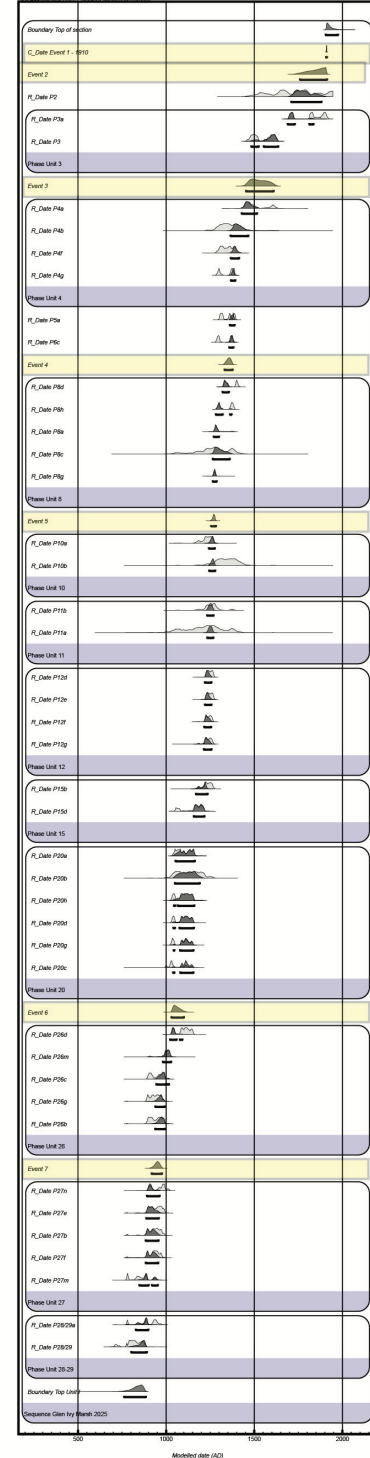


Figure 1. OxCal model for the Glen Ivy dates in stratigraphic order. The yellow bands contain the probability distributions of the earthquake ages interpreted at Glen Ivy.