

Ecography

ECOG-04445

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Supplementary material

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7**Appendix 1**

Table A1.1: Crevice Lake Bayesian age-depth model quantile estimates. Depths of pollen, charcoal, CaCO₃, and δ¹⁸O samples. Age-depth model was generated with the IntCal13 calibration curve (Reimer et al. 2013) and the R Bchron package (Parnell 2018, R Core Team 2018).

Depth (cm)	2.5%	10%	50%	90%	97.5%
12	6	25	31	35	38
12.6	30	32	39	58	92
13.05	36	39	50	81	144
13.4	38	43	58	96	162
13.7	40	46	66	111	173
14.05	41	51	75	124	178
14.45	43	55	86	137	192
14.9	46	59	97	154	198
15.25	48	62	105	168	207
15.6	50	66	114	180	217
16	54	72	123	193	230
16.22	55	75	128	202	235
16.35	56	76	131	205	241
16.7	57	79	139	214	254
17.05	58	85	147	228	262
17.45	59	92	156	238	276
17.8	64	98	162	249	288
18.1	66	101	172	256	299
18.45	69	107	179	264	314
18.8	71	112	185	270	328
19.15	73	117	195	276	343
19.45	75	124	203	283	356
19.75	78	128	212	292	374
20.1	81	136	230	308	387
20.2	82	137	236	314	390
20.4	84	142	246	336	402
20.6	95	149	254	354	416
20.95	111	158	267	380	430
21.4	119	168	283	400	470
21.75	128	179	294	414	479
22.05	137	187	302	426	497
22.35	141	196	309	436	515
22.65	144	201	315	443	530
22.9	151	206	322	452	538
23.11	157	210	326	459	554
23.2	160	211	328	465	562
23.55	170	218	336	475	579
23.9	174	227	345	488	588
24.3	181	233	354	498	607

24.8	187	242	366	515	618
25.2	192	248	374	528	631
25.38	193	250	378	533	640
25.7	196	256	384	540	645
26.15	212	266	393	557	661
26.2	212	267	395	557	661
26.5	217	273	401	561	672
26.85	219	281	409	574	688
27.2	226	289	416	593	710
27.55	228	294	423	606	716
27.8	230	302	428	615	724
28.05	231	308	432	619	733
28.35	233	311	439	624	744
28.6	235	312	446	631	753
28.65	244	312	447	631	755
28.95	248	318	452	636	764
29.2	250	321	456	641	772
29.4	253	324	463	648	775
29.75	256	328	470	655	778
30.1	258	333	478	661	781
30.4	263	336	485	669	786
30.75	268	347	492	675	802
31.1	274	352	499	682	803
31.2	276	354	501	684	803
31.5	280	358	508	691	811
31.9	296	363	517	701	814
32.35	305	375	524	709	823
32.85	314	385	537	717	834
33.05	316	387	541	719	838
33.35	320	391	546	723	839
33.8	326	402	557	730	843
34.25	332	409	567	737	845
34.75	339	415	578	745	853
34.8	340	418	579	746	854
34.97	341	419	583	748	858
35.15	344	424	587	751	858
35.45	348	428	596	756	859
36	356	438	607	762	868
36.45	366	453	615	778	871
36.46	366	453	615	779	871
36.7	375	459	619	790	874
37	379	463	623	796	878
37.35	382	469	631	802	883
37.8	387	480	639	811	889
38.15	392	485	648	814	892
38.45	396	491	656	817	895

38.95	404	497	669	824	900
39.35	406	505	678	832	908
39.6	412	511	684	834	910
39.95	425	520	693	836	912
40.25	434	524	700	840	915
40.4	436	529	703	843	916
40.55	437	533	706	844	917
40.8	440	537	712	849	919
41.15	445	544	718	853	922
41.6	450	552	729	865	925
41.95	455	564	737	868	931
42.25	463	571	745	872	933
42.5	470	579	751	875	934
42.85	475	587	759	880	936
43.3	491	602	771	889	939
43.35	492	602	772	890	939
43.7	496	610	780	893	942
44	502	617	785	896	943
44.45	508	627	794	904	948
44.83	514	640	801	910	959
44.85	514	640	802	911	959
45.1	518	646	807	915	962
45.45	523	658	814	923	973
45.8	540	663	820	930	985
46.1	565	679	827	938	994
46.15	567	679	828	938	996
46.5	574	689	836	942	1002
46.75	592	696	842	946	1004
46.84	601	700	844	948	1004
47.05	621	711	851	954	1005
47.4	640	737	860	959	1012
47.75	654	751	871	968	1017
48.05	677	761	881	973	1022
48.35	681	769	889	980	1027
48.5	690	782	893	983	1029
48.6	708	787	897	984	1031
48.85	718	797	905	989	1041
49.1	745	811	914	1006	1049
49.33	773	824	924	1022	1064
49.58	792	836	937	1038	1108
49.63	802	839	939	1040	1120
49.8	809	844	947	1053	1142
50.05	826	856	959	1065	1191
50.4	836	872	975	1079	1222
50.5	840	876	980	1089	1226
50.7	845	884	988	1102	1244

50.9	854	890	996	1111	1269
51.15	860	900	1006	1125	1280
51.5	866	915	1021	1143	1298
51.85	873	928	1033	1169	1319
52.15	879	936	1044	1187	1327
52.32	882	944	1050	1195	1331
52.45	885	946	1055	1204	1334
52.8	897	957	1068	1220	1348
53.1	905	969	1080	1234	1354
53.3	906	975	1086	1240	1365
53.8	919	993	1101	1256	1383
54.15	926	1004	1114	1265	1391
54.5	933	1016	1125	1281	1405
54.8	940	1022	1135	1294	1414
55.05	944	1028	1142	1307	1421
55.35	948	1035	1152	1317	1429
55.7	951	1046	1164	1324	1439
56.1	954	1058	1179	1341	1450
56.45	960	1068	1193	1354	1459
56.82	968	1080	1206	1365	1466
56.85	970	1081	1207	1365	1466
57.2	981	1085	1219	1371	1477
57.45	986	1093	1229	1379	1483
57.7	996	1101	1238	1384	1486
57.9	1003	1105	1246	1389	1488
58.15	1012	1112	1255	1400	1490
58.4	1015	1118	1264	1404	1496
58.45	1017	1119	1266	1407	1498
58.75	1021	1127	1278	1420	1508
59.1	1036	1136	1291	1437	1523
59.14	1037	1141	1292	1438	1524
59.45	1047	1147	1304	1450	1524
59.75	1054	1153	1315	1459	1531
60.1	1063	1177	1327	1472	1541
60.56	1087	1192	1341	1488	1555
60.6	1090	1194	1344	1490	1557
61	1102	1208	1353	1503	1565
61.3	1113	1219	1363	1517	1577
61.6	1125	1238	1374	1531	1591
61.8	1141	1249	1382	1537	1602
62.45	1176	1283	1406	1562	1631
63	1207	1317	1431	1589	1653
63.4	1275	1341	1453	1618	1681
63.8	1317	1364	1476	1642	1702
64.1	1331	1376	1495	1655	1729
64.3	1342	1386	1504	1663	1752

64.4	1347	1390	1507	1665	1758
64.5	1352	1394	1514	1671	1758
64.55	1355	1396	1516	1673	1764
64.75	1363	1407	1520	1680	1771
65	1369	1418	1530	1689	1778
65.2	1372	1423	1536	1696	1782
65.4	1375	1427	1542	1700	1788
65.6	1380	1431	1547	1708	1793
65.8	1384	1435	1552	1715	1801
66.05	1386	1443	1561	1725	1806
66.35	1389	1449	1570	1736	1814
66.4	1390	1450	1571	1736	1815
66.7	1395	1462	1578	1743	1824
67.1	1401	1474	1591	1757	1830
67.15	1402	1474	1592	1759	1831
67.5	1417	1480	1604	1768	1842
68.05	1429	1493	1619	1779	1851
68.5	1438	1501	1629	1786	1864
68.9	1447	1508	1641	1797	1872
69.42	1460	1515	1657	1815	1883
69.45	1460	1516	1658	1815	1884
69.9	1467	1527	1671	1828	1897
70.1	1468	1534	1675	1833	1907
70.35	1471	1537	1680	1840	1916
70.75	1484	1549	1689	1847	1921
71.15	1488	1557	1701	1856	1934
71.6	1493	1569	1711	1867	1943
72	1500	1576	1724	1876	1955
72.4	1508	1585	1736	1886	1969
72.75	1519	1594	1745	1897	1979
73.1	1527	1602	1754	1911	1995
73.45	1538	1615	1768	1923	2008
73.7	1546	1624	1774	1930	2018
73.95	1549	1629	1782	1937	2029
74.2	1553	1634	1786	1945	2045
74.4	1559	1640	1793	1950	2056
74.94	1569	1655	1809	1970	2078
75	1570	1660	1811	1971	2080
75.5	1583	1681	1836	1987	2100
75.85	1602	1692	1853	2006	2117
76	1618	1697	1860	2013	2126
76.1	1619	1707	1867	2021	2132
76.35	1635	1721	1880	2035	2138
76.63	1649	1735	1892	2051	2147
76.63	1649	1735	1892	2051	2147
76.88	1654	1739	1900	2070	2161

77.13	1668	1748	1905	2089	2171
77.38	1677	1755	1912	2102	2173
77.63	1687	1761	1919	2110	2203
77.88	1694	1769	1925	2117	2215
78	1698	1774	1929	2123	2216
78.125	1701	1777	1932	2124	2219
78.13	1701	1778	1932	2124	2219
78.38	1708	1785	1938	2133	2234
78.65	1716	1793	1945	2136	2241
79	1725	1806	1956	2146	2244
79.3	1733	1814	1963	2156	2253
79.5	1735	1819	1969	2163	2255
79.85	1738	1827	1977	2170	2263
80.3	1743	1836	1987	2183	2271
80.5	1748	1840	1991	2190	2278
80.65	1754	1843	1994	2195	2281
80.9	1764	1849	1999	2199	2286
81.01	1769	1853	2001	2200	2288
81.1	1771	1856	2003	2201	2290
81.25	1773	1859	2006	2207	2293
81.45	1775	1865	2012	2213	2297
81.75	1778	1872	2018	2217	2310
82.05	1782	1879	2025	2227	2312
82.35	1786	1884	2033	2232	2334
82.65	1794	1891	2039	2235	2350
82.7	1796	1892	2040	2235	2351
82.72	1796	1892	2041	2236	2352
83	1806	1898	2048	2245	2359
83.3	1813	1908	2053	2253	2364
83.5	1813	1912	2059	2255	2367
83.8	1821	1921	2064	2257	2372
84.05	1823	1925	2070	2258	2384
84.35	1825	1927	2079	2263	2388
84.75	1827	1935	2088	2274	2401
85	1843	1942	2095	2280	2404
85.05	1845	1943	2097	2281	2404
85.35	1852	1946	2103	2289	2412
85.6	1855	1950	2110	2296	2420
85.85	1858	1952	2114	2302	2429
86.2	1861	1957	2123	2312	2437
86.65	1865	1971	2131	2326	2443
86.82	1867	1975	2135	2329	2445
87.05	1870	1981	2139	2331	2447
87.3	1874	1985	2143	2336	2450
87.5	1876	1988	2145	2339	2453
87.8	1886	1993	2153	2348	2457

88.15	1895	2001	2160	2357	2460
88.45	1899	2008	2168	2363	2464
88.73	1902	2014	2179	2368	2469
89.03	1907	2020	2187	2373	2472
89.3	1910	2023	2193	2379	2473
89.6	1922	2025	2199	2387	2478
89.9	1929	2032	2207	2393	2479
89.95	1932	2032	2208	2394	2479
90.25	1935	2037	2214	2400	2481
90.6	1957	2042	2222	2408	2493
90.9	1958	2047	2227	2418	2497
91.15	1959	2049	2232	2422	2500
91.5	1961	2056	2238	2428	2505
91.9	1977	2066	2245	2434	2510
92.3	1988	2073	2253	2443	2514
92.7	1991	2081	2261	2451	2519
92.8	1991	2084	2263	2453	2520
93.1	1993	2092	2269	2457	2529
93.5	1998	2101	2278	2462	2535
93.52	1999	2101	2278	2462	2535
93.85	2009	2110	2286	2468	2541
94.15	2013	2114	2291	2472	2542
94.45	2016	2121	2299	2476	2544
94.7	2017	2129	2306	2480	2552
94.9	2019	2134	2309	2485	2554
95.1	2020	2139	2312	2492	2556
95.15	2020	2140	2313	2493	2557
95.45	2023	2146	2318	2499	2560
95.75	2034	2151	2326	2502	2564
95.89	2043	2152	2329	2504	2565
96.05	2051	2156	2332	2506	2566
96.3	2053	2165	2339	2511	2570
96.55	2054	2171	2344	2515	2577
96.8	2057	2181	2349	2521	2581
97.1	2064	2188	2355	2528	2584
97.5	2068	2198	2364	2535	2590
97.7	2070	2202	2367	2539	2591
97.95	2073	2217	2372	2543	2597
98.3	2088	2227	2380	2550	2603
98.55	2099	2230	2386	2554	2615
98.95	2109	2242	2395	2563	2622
98.96	2110	2243	2395	2563	2622
99.45	2124	2249	2406	2571	2629
99.95	2143	2262	2415	2582	2637
100.4	2158	2275	2427	2590	2643
100.8	2181	2283	2438	2599	2648

101	2192	2290	2441	2605	2651
101.25	2208	2304	2447	2612	2653
101.7	2224	2317	2460	2621	2662
102.05	2239	2324	2468	2628	2666
102.45	2242	2333	2477	2636	2677
102.9	2277	2348	2489	2647	2687
103.3	2291	2360	2501	2656	2700
103.65	2319	2372	2516	2665	2710
104.1	2337	2385	2532	2676	2725
104.4	2349	2394	2547	2695	2739
104.65	2359	2399	2557	2712	2760
105.05	2374	2409	2576	2728	2823
105.17	2378	2411	2580	2736	2835
105.5	2384	2416	2591	2750	2861
106	2390	2423	2606	2790	2891
106.45	2392	2432	2615	2808	2922
106.95	2394	2438	2632	2818	2970
107.5	2395	2446	2645	2842	3000
107.9	2396	2450	2651	2860	3033
107.95	2396	2451	2651	2861	3037
108.25	2397	2455	2658	2868	3064
108.55	2398	2459	2664	2884	3081
108.95	2400	2467	2668	2902	3105
109.26	2401	2469	2673	2917	3109
109.5	2401	2472	2675	2919	3119
110.1	2403	2479	2687	2943	3143
110.55	2405	2481	2692	2960	3161
110.9	2405	2483	2697	2975	3178
111.3	2406	2485	2705	2984	3202
111.4	2406	2485	2706	2989	3204
111.7	2407	2488	2708	3007	3224
112.45	2410	2493	2717	3038	3285
115.45	2415	2506	2769	3133	3466
115.93	2417	2508	2773	3139	3483
117.95	2421	2521	2793	3185	3589
119.95	2427	2534	2821	3258	3683
124.67	2440	2557	2911	3391	3848

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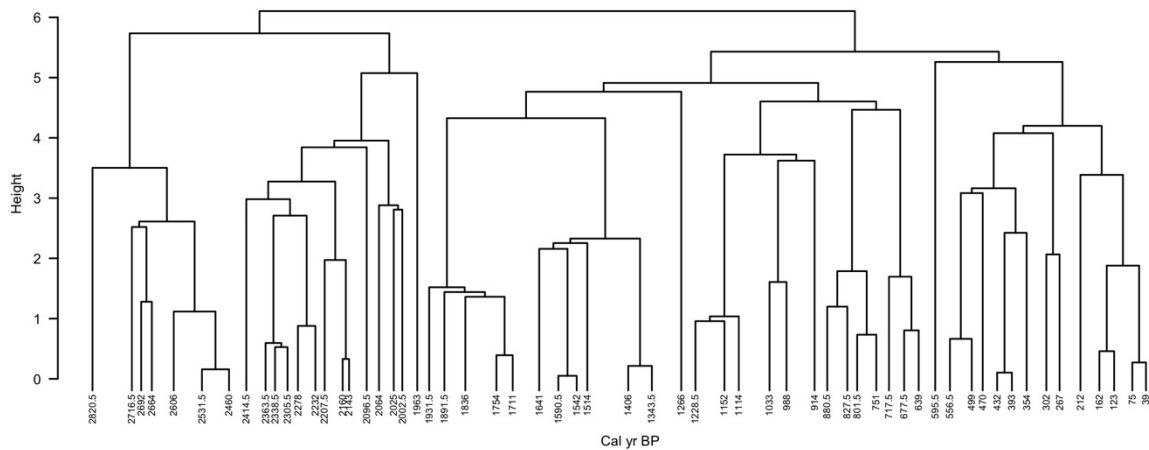
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22 cal BP. — *Radiocarbon* 55: 1869–1887.
23

24 **Appendix 2:**
 25 **Figure A2.1. Stratigraphically constrained cluster analysis.** Cal yr BP = Calendar years
 26 before present.



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 29 **Table A2.1. Broken stick test of stratigraphically constrained cluster analysis.** N groups =
 30 number of hierarchical clusters.

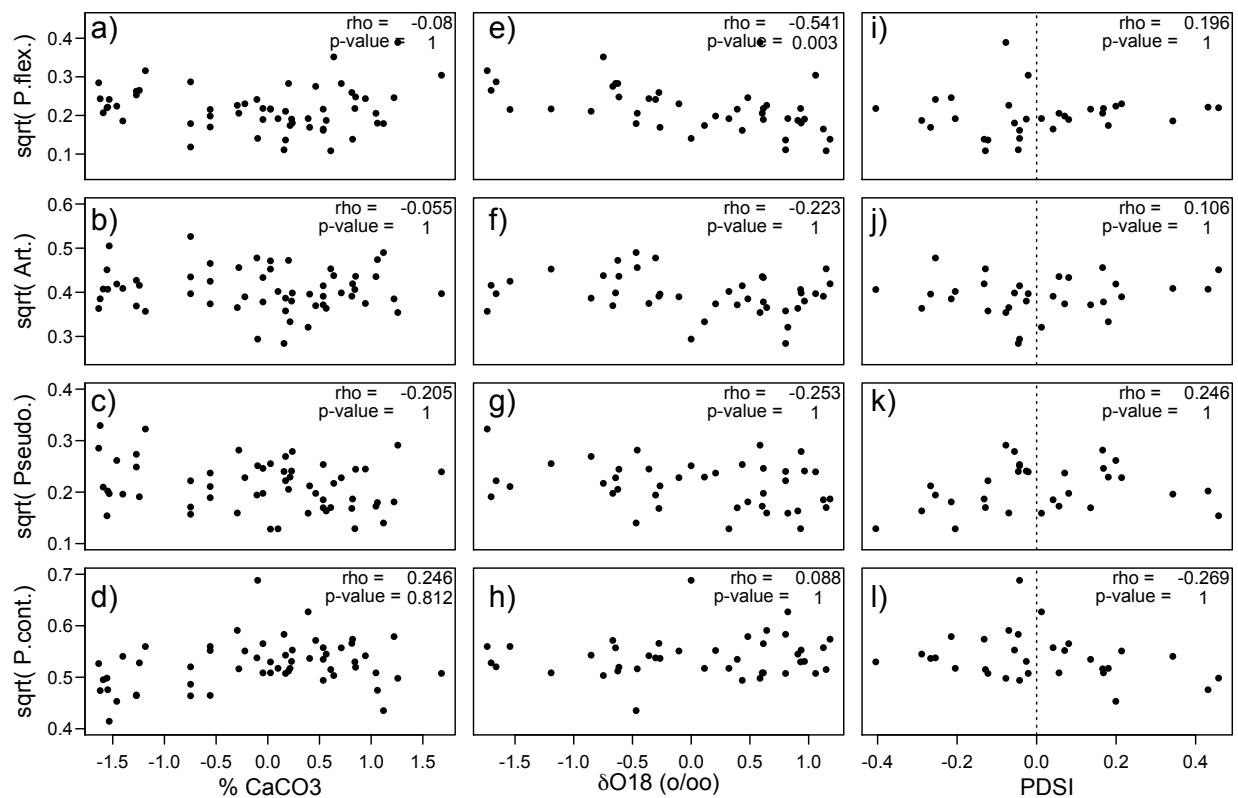
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N groups	Empirical Dispersion	Broken-stick Dispersion
2	0.369	0.482
3	0.304	0.379
4	0.171	0.327
5	0.185	0.293
6	0.163	0.267
7	0.146	0.246
8	0.162	0.229
9	0.137	0.214
10	0.140	0.201

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36 **Appendix 3**

37 **Figure A2.1. Pollen abundance versus climate proxies in the 100 years preceding pollen**
 38 **samples.** Pollen abundance is square-root-transformed proportion; $\delta^{18}\text{O}$ units are o/oo Vienna
 39 Pee Dee Belemnite carbonate standard (VPDB). CaCO_3 = calcium carbonate; PDSI = Palmer
 40 drought severity index; P.flex. = *Pinus flexilis*/*P. albicaulis*-type; Art.=*Artemisia*; Pseudo =
 41 *Pseudotsuga*-type; P.cont. = *Pinus contorta*-type; rho = Spearman's rho.
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46 **Appendix 4**

47 **Table A3.1: Log likelihood ratio model comparisons for Autoregressive lag-1 models with**
 48 **and without charcoal peak*climate interaction terms.** CaCO₃ = calcium carbonate; PDSI =
 49 Palmer drought severity index. $\delta^{18}\text{O}$ units are o/oo Vienna Pee Dee Belemnite carbonate
 50 standard (VPDB).
 51

Pollen type	Climate proxy	Log Likelihood Model without charcoal*climate (df=5)	Log Likelihood Model with charcoal*climate (df=6)	P value
<i>Pinus flexilis/ P.albicaulis</i> -type	% CaCO ₃	82.464	82.663	0.527
	$\delta^{18}\text{O}$	57.528	57.528	0.985
	PDSI	52.934	53.297	0.394
<i>Artemisia</i>	% CaCO ₃	91.416	91.45	0.794
	$\delta^{18}\text{O}$	68.873	69.087	0.513
	PDSI	60.637	60.682	0.764
<i>Pseudotsuga</i> -type	% CaCO ₃	94.492	94.511	0.845
	$\delta^{18}\text{O}$	73.367	73.396	0.809
	PDSI	61.025	61.503	0.328
<i>Pinus contorta</i> -type	% CaCO ₃	94.998	95.743	0.222
	$\delta^{18}\text{O}$	71.704	72.226	0.307
	PDSI	60.611	60.611	0.998

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