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DATA REPOSITORY 2010064 **Bywater-Reyes et al.**

U-Pb GEOCHRONOLOGY Epoxy grain mounts of hand-selected zircons were ground and polished to expose grain interiors. After ultrasonic cleaning with soapy water, diluted HCl and distilled water, the Au-coated mounts were transferred into a high vacuum chamber (>10^{-8} Torr) and kept overnight. Zircon analysis was performed using the UCLA Cameca ims 1270 ion microprobe with a mass-filtered, ~15 nÅ $^{16}O^-$ beam focused to a 25-30 µm diameter spot. The sample chamber was flooded with O_2 at a pressure of ca. 4 x 10^{-3} Pa to enhance Pb^+ yields by roughly a factor of 1.5. Secondary ions were extracted at 10 kV with an energy band pass of 50 eV. Following a 4 min pre-sputter period during which secondary beam alignment, mass centering, and charge compensation routines are automatically applied, intensities for $^{94}Zr_2O^+$, $^{204}Pb^+$, $^{206}Pb^+$, $^{207}Pb^+$, $^{208}Pb^+$, $^{238}U^+$, $^{232}Th^{16}O^+$ and $^{238}U^{16}O^+$ were sequentially measured in 10 cycles at a mass resolution of ca. 4800, which is sufficient to resolve most molecular interferences.

The relative sensitivities for Pb and U were determined on reference zircon AS-3 (Paces and Miller, 1993) using a calibration technique similar to Compston et al. (1984). U and Th contents (Table DR1) were calculated from $^{238}U^{16}O^+$/ $^{94}Zr^2O^+$ and Th^+/U^+ calibrated on reference zircon 91500 (Wiedenbeck et al., 2004). Unknown $^{206}Pb/^{238}U$ ages were calculated from common-Pb and disequilibrium corrected U/Pb isotopic ratios. Corrections for common-Pb are based on anthropogenic compositions (Sañudo-Wilhelmy and Flegal, 1994) and initial disequilibrium ^{230}Th was calculated from measured Th/U_{zircon} and a model Th/U_{melt}, using the average Th/U value for Southern Central Andes ignimbrites (Siebel et al., 2001). Approximately ten grains per sample were then analyzed. See Table DR1 for results.

Note that the youngest $^{206}Pb/^{238}U$ zircon age, 2.3 ± 0.2 Ma located ~1110 m above the Palo Pintado Fm.-San Felipe Fm. boundary, is unpublished data of John Trimble who will be publishing the data soon.

To rule out the possibility of the San Felipe Fm. representing a time-transgressive progradation of coarse material within the basin, a second ash collected more than 5 km more proximally to western sources was dated. This ash, located 135 m above the Palo Pintado Fm.-San Felipe Fm. transition, yielded a U-Pb zircon date of 5.17 ± 0.23 Ma (AT4–3, Table DR1). The calculated age for the more distal transect for this stratigraphic level is 4.84 ± 0.17 Ma (assuming a constant sedimentation rate calculated between age of AT2–7 and AT2–2, Table DR1). These ages agree within error. Therefore, the shift from the finer-grained Palo Pintado Fm. to the coarser-grained San Felipe Fm. occurs basin-wide quickly as can be detected via U-Pb dating.

STABLE ISOTOPE ANALYSIS

Pedogenic Carbonate Nodules

Samples were collected at >30 cm depth from the top of the paleosol to ensure atmospheric CO_2 input was negligible (Koch, 1998). Samples were powdered and analyzed for organic and inorganic carbon content at the University of Wyoming Department of Geology and Geophysics and $\delta^{13}C$ and $\delta^{18}O$ values were determined at the University of Wyoming Stable Isotope Facility. Pedogenic carbonate nodules were sliced in half using a wet rock saw and three powder samples (> 1 mg) were taken from the center of each nodule using a Dremel drill. Care was taken to sample only the micrite in the nodules and to avoid spar or secondary calcite. Approximately 1.5 mg of soil carbonate was analyzed on a GasBench peripheral device attached to a Thermo Finnigan $Delta^{Plus}$ XP continuous flow IRMS. In-house calcite standard referenced to NBS-19 had precision less than ± 0.2 ‰ for both carbon and oxygen isotope measurements. Results are expressed in standard delta notation:

$$\delta\ (‰) = (R_{sample}/R_{standard} - 1)*1000,$$

where R_{sample} is the observed isotope ratio of the sample ($^{13}C/^{12}C$ or $^{18}O/^{16}O$) and $R_{standard}$ is the accepted ratio for an appropriate international standard ($\delta^{13}C$: V-PDB; $\delta^{18}O$ = V-SMOW). Analytical precision is typically better than 0.1 ‰ for $d^{13}C$ values and 0.2 ‰ for $d^{18}O$ values (± 1 σ). Results are reported in Table DR2. In order to evaluate possible diagenetic alteration of the carbonate, major element oxide weight percentages were calculated by lithium metaborate fusion and ICP-OES at the University of Wyoming Department of Geology and Geophysics (Table DR3).

Rodent Enamel

Specimens of rodent tooth enamel selected for analysis are listed in Table DR4. When available, three or more specimens of each species were analyzed to provide a robust estimate of the population mean and standard deviation for carbon and oxygen isotope values (Clementz and Koch, 2001). Specimens were collected as isolated incisors in the field, which made taxonomic identification difficult. Based on the size, general morphology and double-layering of enamel in each incisor, all specimens could be referred to the order Rodentia, but lower taxonomic assignment was not possible. Based on differences in incisor size, specimens represent a minimum of one species from the lower level and at least two species in the upper level, with similarly-sized individuals found in both levels. Diets for rodents can be extremely specialized, so changes in $\delta^{13}C$ values could represent selective sampling of plant types by different species from each level. However, we would expect a stronger overlap in enamel $\delta^{13}C$ values among specimens sampled from each level if this were the case and the clear separation of values based on stratigraphic position rather than morphology (i.e., size) suggests that the carbon isotope shift is more a reflection of a local vegetation change rather than dietary differences between species. Thus, even with the small sample size, our enamel carbon isotope results are sufficient to support an interpretation of increasing C4 or CAM plant abundance in the area.

Approximately 5 mg of enamel powder was collected from each specimen either by drilling directly from the tooth or by grinding enamel chips in an agate mortar and pestle. Prior to collection, contaminants were removed by abrading the outer surface of the specimen. Preparation of powders for stable isotope analysis follow published methods (Koch et al., 1997). Powders were first transferred to 1 ml microcentrifuge vials and then soaked sequentially overnight in 0.20 ml of a 1-2 wt % sodium hypochlorite solution and then in 0.20 ml of calcium acetate buffered acetic acid (pH ≈ 5.1). Upon addition of each reagent, samples were agitated on a Vortex Genie for one minute. Following each soak, the supernatant was removed by aspiration and the residual powder was rinsed 5 times with deionized water. Samples were then freeze-dried over night and approximately 1.5 mg of powder from each was weighed into individual test tubes for analysis on a Thermo-Finnigan Gas Bench autosampler attached to a Thermo Finnigan Delta^{Plus} XP continuous flow isotope ratio mass spectrometer at the University of Wyoming Stable Isotope Facility.

All stable isotope values are reported in delta (δ) notation using the following equation

$$\delta\ (‰) = (R_{sample}/R_{standard} - 1)*1000$$

where R_{sample} is the observed isotope ratio of the sample ($^{13}C/^{12}C$ or $^{18}O/^{16}O$) and $R_{standard}$ is the accepted ratio for an appropriate international standard ($\delta^{13}C$: V-PDB; $\delta^{18}O$ = V-SMOW). Analytical precision is typically better than 0.1 ‰ for $d^{13}C$ values and 0.2 ‰ for $d^{18}O$ values (± 1 σ).

Estimates of C4 grass contribution to rodent diets were calculated using a simple linear mixing model. A discrimination factor between tooth enamel $\delta^{13}C$ and diet $\delta^{13}C$ values ($\Delta^{13}C_{enamel\text{-}diet}$) of 11.0 ‰ based on recently published values for two species of wood rats (Podlesak et al., 2008) and voles (Passey et al, 2005). Published late Miocene end-member plant values for pure C3 and pure C4 growing under normal and arid conditions were used in the model (Passey et al., 2002). Results for each specimen are reported in Table DR4.

The samples (two different individuals) located 75 m below the transition yielded $\delta^{13}C$ values of −10.2 ‰ and −11.1 ‰ and $\delta^{18}O$ values of −7.9 ‰ and −7.4 ‰, respectively, with a weighted mean $\delta^{13}C$ value of −10.60 ± 0.65 ‰ and $\delta^{18}O$ value of −7.61 ± 0.37 ‰ (Fig. 2A and Table DR 4). The samples (four different individuals) located 84 m above the transition yielded $\delta^{13}C$ values of −2.5 ‰, −3.2 ‰, −4.4 ‰ and −6.6 ‰ and $\delta^{18}O$ values of −2.6 ‰, −4.1 ‰, −4.8 ‰ and −5.2 ‰, respectively, with a weighted mean $\delta^{13}C$ of −4.18 ± 1.78‰ and $\delta^{18}O$ value of −4.17 ± 1.15‰ (Fig. 2A; Table DR 4).

Since $\delta^{13}C$ values of rodent incisor enamel reflect the vegetation they eat (Kohn and Cerling, 2002), the values from below the transition indicate the predominance of C3 plants, whereas the values above the transition indicate C4 grasses or ^{13}C enriched CAM plants (e.g., cacti and other succulents) made up at least 35 % and possibly as much at 87 % of the diet of these rodents (DR). This indicates that prior to ~5 Ma, C4 and CAM plants were not present in any substantial quantity. Therefore, the trend in stable isotope values of samples older than ~5 Ma (from the Palo Pintado Fm.) can thus be attributed to a change in environmental stress on resident C3 plants. C4 grasses and CAM plants generally take advantage of arid conditions since they can tolerate drier conditions than C3 grasses, so it seems reasonable that the ecosystem would be replaced by C4 grasses or include a greater proportion of CAM plants as conditions became drier (Ehleringer et al., 1997). Studies in nearby basins have found the expansion of C4 plants since ~7 Ma (e.g., Latorre et al., 1997, Kleinert and Strecker, 2001), synchronous with the worldwide expansion found by other studies (e.g., Cerling et al., 1997; Pagani et al., 1999).

Enamel $\delta^{18}O$ values for rodents track the $\delta^{18}O$ composition of body water, which is strongly influenced by drinking water (56%; Podlesak et al., 2008). The increase in $\delta^{18}O$ values is consistent with an increase in temperature and aridity. Given the associated $\delta^{13}C$ evidence for C4 grasses or CAM plants in the diets of these rodents, an interpretation of increasing aridity through this interval is favored.

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DATA REPOSITORY TABLE DR1. ZIRCON U-Pb RESULTS*

Sample-grain	238U/206Pb	238U/206Pb (1 s.e.)	207Pb*/206Pb*	207Pb*/206Pb* (1 s.e.)	Correlation of Concordia Ellipses	206Pb/238U age (Ma)	± 1 s (Ma)	U (ppm)	UO/O	206Pb* (%)	weighted mean (Ma)	± 2 s (Ma)	MSWD	Stratigraphic Position Relative to the Palo Pintado San Felipe Boundary (m)	lat	long
AT6-7-g9	1941.4	135.7	0.0855	0.0080	-0.27	3.22	0.24	379	8.6	95.0	3.28	0.21	0.27	769	-25.67097	-66.02937
AT6-7-g10	1280.1	86.8	0.3013	0.0104	-0.17	3.45	0.38	522	8.6	67.4						
AT3-11-g1	57.5	2.3	0.7924	0.0093	0.00	5.20	6.35	285	9.2	4.6	3.99	0.15	0.88	627	-25.72729	-66.00683
AT3-11-g3	1464.1	79.3	0.1581	0.0158	-0.30	3.85	0.26	212	9.1	85.7						
AT3-11-g4	1398.0	80.1	0.1696	0.0310	-0.19	3.95	0.33	181	9.1	84.2						
AT3-11-g5	1652.6	57.4	0.0631	0.0043	-0.14	3.87	0.14	3393	9.2	97.8						
AT3-11-g6	1575.3	66.8	0.1015	0.0116	-0.10	3.88	0.18	583	9.2	92.9						
AT3-11-g7	1465.0	54.7	0.0741	0.0042	0.00	4.24	0.17	1487	9.3	96.4						
AT3-11-g8	1602.3	77.5	0.1075	0.0157	-0.23	3.79	0.21	480	9.0	92.1						
AT3-11-g11	1399.0	67.7	0.1018	0.0147	-0.27	4.36	0.24	546	9.0	92.9						
AT3-11-g15	779.4	65.6	0.4430	0.0197	-0.24	4.15	0.88	153	9.2	49.3						
AT3-9-g2	1732.5	116.2	0.0621	0.0069	0.11	3.71	0.25	857.7	8.4	98.0	4.04	0.26	1.28	545	-25.72762	-66.00762
AT3-9-g3	1777.1	133.0	0.0698	0.0095	-0.01	3.58	0.28	293.7	8.6	97.0						
AT3-9-g4	1483.5	127.0	0.0785	0.0111	0.04	4.22	0.38	471.9	8.1	95.9						
AT3-9-g6	1435.5	111.7	0.0564	0.0046	-0.02	4.51	0.35	1054	8.2	98.7						
AT3-9-g7	1528.6	122.0	0.0644	0.0054	-0.05	4.21	0.34	1070	8.2	97.7						
AT3-9-g8	1521.6	142.4	0.0889	0.0103	-0.16	4.06	0.4	316.6	8.1	94.5						
AT3-9-g12	1523.0	139.2	0.0769	0.0096	0.06	4.13	0.39	399.2	8.1	96.1						
AT3-9-g15	1420.7	106.4	0.0505	0.0037	-0.05	4.53	0.34	1314	8.2	99.4						
AT6-1-g1	1401.0	75.4	0.0564	0.0039	0.05	4.64	0.25	2666	8.5	98.7	4.61	0.16	1.22	465	-25.6747	-66.03867
AT6-1-g2	1400.6	67.7	0.0661	0.0038	-0.15	4.58	0.22	1686	8.6	97.5						
AT6-1-g3	1305.7	84.9	0.0542	0.0030	0.00	4.98	0.32	1937	8.6	99.0						
AT6-1-g4	1337.8	64.2	0.0551	0.0019	0.05	4.86	0.23	4697	8.7	98.9						
AT6-1-g5	1442.0	67.8	0.0482	0.0029	-0.01	4.55	0.21	1979	8.8	99.7						
AT6-1-g6	1483.9	80.4	0.0532	0.0031	-0.24	4.41	0.24	2085	8.7	99.1						
AT6-1-g7	1299.5	53.4	0.0557	0.0040	0.02	5.00	0.21	1489	9.0	98.8						
AT6-1-g8	1521.4	71.5	0.0539	0.0031	-0.03	4.30	0.20	2659	8.9	99.0						
AT6-1-g11	1323.5	94.6	0.0716	0.0055	-0.06	4.78	0.35	756	8.3	96.7						
AT6-1-g13	1487.4	68.8	0.0569	0.0053	-0.19	4.37	0.20	1554	8.7	98.6						
AT2-7-g1	1412.6	104.6	0.0533	0.0036	-0.03	4.62	0.34	1936	8.2	99.1	4.81	0.17	0.66	149	-25.72948	-66.01943
AT2-7-g3	1495.7	112.7	0.0525	0.0035	0.00	4.38	0.33	2176	8.2	99.2						
AT2-7-g4	1377.2	109.4	0.0595	0.0044	-0.02	4.70	0.37	942.1	8.1	98.3						
AT2-7-g5	1342.3	98.0	0.0559	0.0025	0.00	4.84	0.35	2822	8.2	98.7						
AT2-7-g6	1336.0	100.0	0.0538	0.0025	0.02	4.88	0.36	3069	8.2	99.0						
AT2-7-g7	1325.0	101.1	0.0478	0.0022	0.09	4.95	0.37	2861	8.3	99.8						
AT2-7-g8	1318.6	106.4	0.0494	0.0028	0.01	4.97	0.4	1971	8.0	99.6						

Sample-grain	238U/206Pb	238U/206Pb (1 s.e.)	207Pb*/206Pb*	207Pb*/206Pb* (1 s.e.)	Correlation of Concordia Ellipses	206Pb/238U age (Ma)	± 1 s (Ma)	U (ppm)	UO/O	206Pb* (%)	weighted mean (Ma)	± 2 s (Ma)	MSWD	Stratigraphic Position Relative to the Palo Pintado San Felipe Boundary (m)	lat	long
AT2-7-g9	1358.0	111.9	0.0500	0.0035	0.03	4.82	0.39	1602	8.1	99.5						
AT2-7-g10	1313.9	87.9	0.0524	0.0029	0.01	4.97	0.33	1494	8.4	99.2						
AT2-7-g12	1170.5	86.0	0.0518	0.0046	-0.10	5.56	0.41	1005	8.2	99.3						
AT2-7-g13	1419.2	94.9	0.0469	0.0021	0.01	4.61	0.3	3699	8.4	99.9						
AT4-3-g1	1381.6	63.6	0.0589	0.0059	-0.05	4.67	0.22	563.2	9.1	98.4	5.17	0.23	2.00	135	-25.67716	-66.07311
AT4-3-g2	1206.3	61.3	0.0562	0.0027	-0.02	5.37	0.27	2257	8.5	98.7						
AT4-3-g3	1289.2	69.3	0.0661	0.0039	-0.09	4.97	0.27	1074	8.8	97.4						
AT4-3-g4	1132.6	67.1	0.0755	0.0058	0.27	5.57	0.34	1404	8.4	96.2						
AT4-3-g5	1235.0	63.3	0.0592	0.0042	0.13	5.23	0.27	1045	8.7	98.3						
AT4-3-g6	1338.9	54.0	0.0598	0.0036	0.20	4.83	0.2	1216	9.2	98.3						
AT4-3-g7	1229.1	60.6	0.0562	0.0039	-0.10	5.27	0.26	1469	8.7	98.7						
AT4-3-g8	1259.0	62.9	0.0583	0.0035	-0.11	5.13	0.26	1259	8.8	98.4						
AT4-3-g11	1147.6	51.5	0.0522	0.0036	-0.10	5.67	0.25	986.8	9.0	99.2						
AT4-3-g13	1149.7	54.5	0.0543	0.0027	-0.06	5.64	0.27	1633	8.8	99.0						
AT2-2-g1	1196.9	50.9	0.0807	0.0099	0.19	5.23	0.24	696	9.1	95.6	4.95	0.16	0.45	80	-25.73092	-66.03101
AT2-2-g2	1224.0	55.6	0.1036	0.0158	-0.19	4.97	0.26	460	9.1	92.7						
AT2-2-g3	1251.9	57.2	0.0953	0.0124	-0.30	4.87	0.25	504	9.2	93.7						
AT2-2-g4	1187.9	54.5	0.1402	0.0226	-0.22	4.85	0.30	238	9.3	88.0						
AT2-2-g5	940.7	60.2	0.2151	0.0327	-0.22	5.44	0.54	119	9.3	78.4						
AT2-2-g6	1307.0	54.8	0.0712	0.0094	0.26	4.85	0.21	774	9.2	96.8						
AT2-2-g7	1127.5	54.2	0.1631	0.0205	0.16	4.93	0.31	219	9.2	85.0						
AT2-2-g8	1154.9	63.0	0.1010	0.0123	0.03	5.26	0.32	318	9.1	93.0						
AT2-2-g9	1204.2	52.4	0.1304	0.0196	-0.23	4.83	0.27	428	9.1	89.2						
AT2-2-g10	1214.9	49.6	0.1095	0.0084	0.14	4.94	0.22	493	9.1	91.9						
AT2-2-g11	1135.6	62.3	0.1944	0.0185	0.16	4.67	0.34	164	9.3	81.0						
AT7-10-g1	982.3	67.0	0.0518	0.0030	-0.03	6.61	0.45	1964	8.3	99.3	5.98	0.32	1.93	-271	-25.67459	-66.07721
AT7-10-g3	967.1	54.4	0.0528	0.0021	-0.04	6.70	0.38	3005	8.7	99.2						
AT7-10-g4	1267.9	68.5	0.0490	0.0030	0.24	5.16	0.28	2003	9.1	99.6						
AT7-10-g5	1096.6	69.5	0.0547	0.0032	0.08	5.90	0.37	1558	8.6	98.9						
AT7-10-g8	1115.4	40.1	0.0505	0.0017	0.02	5.84	0.32	2878	9.9	99.5						
AT7-10-g11	1066.4	57.9	0.0511	0.0022	-0.06	6.10	0.34	3274	8.9	99.4						
AT7-10-g12	1095.5	56.5	0.0472	0.0022	0.06	5.97	0.33	2595	9.0	99.9						
AT7-10-g13	1030.7	52.5	0.0481	0.0015	0.07	6.34	0.35	5989	9.0	99.8						
AT7-10-g14	1078.4	55.6	0.0560	0.0028	-0.05	6.00	0.33	2366	8.9	98.7						
AT1-1-g1	871.1	39.4	0.0732	0.0089	-0.37	7.23	0.35	559	9.4	96.5	7.24	0.26	0.39	-674	-25.77111	-66.05959
AT1-1-g2	806.5	46.8	0.1667	0.0374	0.02	6.83	0.59	122	9.5	84.6						
AT1-1-g3	862.1	35.4	0.0686	0.0056	-0.14	7.35	0.31	1655	9.2	97.1						

Sample-grain	238U/206Pb	238U/206Pb (1 s.e.)	207Pb*/206Pb*	207Pb*/206Pb* (1 s.e.)	Correlation of Concordia Ellipses	206Pb/238U age (Ma)	± 1 s (Ma)	U (ppm)	UO/O	206Pb* (%)	weighted mean (Ma)	± 2 s (Ma)	MSWD	Stratigraphic Position Relative to the Palo Pintado San Felipe Boundary (m)	lat	long
AT1-1-g4	113.3	6.7	0.7352	0.0166	-0.04	6.84	4.73	393	8.7	11.9						
AT1-1-g5	908.3	38.7	0.0703	0.0094	-0.02	6.96	0.31	835	9.3	96.9						
AT1-1-g6	873.4	37.5	0.0764	0.0094	-0.25	7.13	0.33	767	9.5	96.1						
AT1-1-g7	871.8	33.7	0.0666	0.0082	-0.29	7.27	0.30	765	9.4	97.4						
AT1-1-g8	818.3	41.7	0.0778	0.0072	-0.13	7.64	0.41	546	8.9	96.0						
AT1-1-g9	745.7	44.3	0.1420	0.0145	-0.04	7.66	0.54	194	9.3	87.7						

*See DR for details of methods used

DATA REPOSITORY TABLE DR2. PALEOSOL CARBONATE NODULE CARBON CONTENT AND STABLE ISOTOPE DATA*

Sample-aliquot	Total Carbon (%)	Total Inorganic Carbon (%)	Total Organic Carbon (%)	δ^{13}C (‰)	Mean δ^{13}C (‰)	std. dev. (‰)	δ^{18}O (‰)	Mean δ^{18}0 (‰)	std. dev. (‰)	Stratigraphic Position Relative to the Palo Pintado San Felipe Boundary (m)	lat	long
AT5-16a	7.3	7.36	-0.06							792	-25.6491	-66.0533
AT5-16a-a1				-8.84	-8.86	0.10	-6.13	-6.10	0.10			
AT5-16a-a2				-8.89			-6.07					
AT5-16a-b1				-9.06	-9.15	0.12	-6.15	-6.13	0.10			
AT5-16a-b2				-9.23			-6.11					
AT5-16a-c1				-8.61	-8.66	0.07	-6.07	-6.02	0.08			
AT5-16a-c2				-8.72			-5.96					
AT6-2	4.5	4.6	-0.09							350	-25.6734	-66.0345
AT6-2-a1				-9.26	-9.32	0.08	-5.04	-5.29	0.35			
AT6-2-a2				-9.37			-5.54					
AT6-2-b1				-9.14	-8.89	0.35	-5.52	-5.56	0.06			
AT6-2-b2				-8.65			-5.60					
AT6-2-c1				-9.01	na	na	-5.74	na	na			
AT4-4	5.55	5.06	0.49							176	-25.6771	-66.0726
AT4-4-a1				-9.35	-9.41	0.08	-5.76	-5.72	0.06			
AT4-4-a2				-9.47			-5.68					
AT4-4-c1				-9.52	-9.50	0.10	-5.82	-5.81	0.10			
AT4-4-c2				-9.49			-5.81					
AT4-4-d1				-9.39	-9.36	0.10	-5.50	-5.58	0.11			
AT4-4-d2				-9.33			-5.66					

Sample-aliquot	Total Carbon (%)	Total Inorganic Carbon (%)	Total Organic Carbon (%)	$\delta^{13}C$ (‰)	Mean $\delta^{13}C$ (‰)	std. dev. (‰)	$\delta^{18}O$ (‰)	Mean $\delta^{18}0$ (‰)	std. dev. (‰)	Stratigraphic Position Relative to the Palo Pintado San Felipe Boundary (m)	lat	long
AT2-4d	5.39	5.53	-0.15							84	-25.7309	-66.03
AT2-4d-a1				-9.09	-9.10	0.10	-5.54	-5.51	0.10			
AT2-4d-a2				-9.11			-5.48					
AT2-4d-b1				-8.24	-8.17	0.10	-5.23	-5.28	0.07			
AT2-4d-b2				-8.10			-5.32					
AT2-4d-c1				-8.51	-8.30	0.29	-5.20	-5.19	0.10			
AT2-4d-c2				-8.09			-5.18					
AT2-4d-d1				-8.58	-8.44	0.20	-5.31	-5.33	0.10			
AT2-4d-d2				-8.30			-5.35					
AT4-2	5.71	5.62	0.09							-147	-25.6761	-66.0766
AT4-2-a1				-11.19	-11.37	0.25	-5.99	-5.90	0.14			
AT4-2-a2				-11.55			-5.80					
AT4-2-d1				-10.56	-10.46	0.14	-5.80	-5.85	0.07			
AT4-2-e1				-10.25	-10.31	0.09	-5.86	-5.88	0.10			
AT4-2-e2				-10.37			-5.91					
AT4-2-f1				-11.17	na	na	-6.44	na	na			
AT5-4b	5.47	5.34	0.14							-312	-25.6517	-66.0707
AT5-4b-a1				-10.42	-10.24	0.25	-5.94	-5.93	0.10			
AT5-4b-a2				-10.06			-5.93					
AT5-4b-b1				-10.56	-10.54	0.10	-6.48	-6.35	0.18			

AT5-4b-b2				-10.53			-6.23					
AT7-9	5.07	5.08	-0.01							-336	-25.6743	-66.0779
AT7-9-a1				-12.33	-12.38	0.07	-6.43	-6.46	0.10			
AT7-9-a2				-12.43			-6.49					
AT7-9-b1				-12.24	-12.30	0.07	-6.40	-6.39	0.10			
AT7-9-b2				-12.35			-6.37					
AT7-9-c1				-11.93	-12.03	0.14	-6.52	-6.50	0.10			
AT7-9-c2				-12.13			-6.49					
AT5-3	8.30	8.18	0.12							-341	-25.6512	-66.0714
AT5-3-a1				-15.48	-15.36	0.17	-6.91	-6.92	0.10			
AT5-3-a2				-15.24			-6.93					
AT5-3-b1				-14.92	-15.03	0.15	-6.50	-6.67	0.23			
AT5-3-b2				-15.14			-6.83					
AT5-3-d1				-13.79	-13.80	0.10	-5.97	-6.15	0.25			
AT5-3-d2				-13.81			-6.33					
AT7-7	6.63	6.61	0.02							-515	-25.677	-66.081
AT7-7-a1				-11.66	-11.78	0.18	-3.90	-3.95	0.07			
AT7-7-a2				-11.91			-4.00					
AT7-7-b1				-11.83	-11.77	0.09	-4.00	-4.14	0.20			
AT7-7-b2				-11.70			-4.28					
AT7-6	4.47	4.41	0.06							-558	-25.6784	-66.0817
AT7-6-b1				-13.92	na	na	-6.51	na	na			

AT7-2b	5.74	5.53	0.21							-948	-25.6752	-66.0864
AT7-2b-a1				-13.53	na	na	-7.88	na	na			
AT7-2b-b1				-13.21	na	na	-8.25	na	na			
AT7-2b-c1				-13.49	-13.43	0.08	-8.69	-8.64	0.08			
AT7-2b-c2				-13.38			-8.59					
AT7-2b-d1				-14.26	-14.41	0.22	-9.71	-9.62	0.13			
AT7-2b-d2				-14.56			-9.52					

DATA REPOSITORY TABLE DR3. PALEOSOL CARBONATE NODULE MAJOR ELEMENT OXIDE WEIGHT PERCENTAGES*

Sample	SiO_2 (WT. %)	Al_2O_3 (WT. %)	CaO (WT. %)	MgO (WT. %)	TiO_2 (WT. %)	Fe_2O_3 (WT. %)	MnO (WT. %)	Na_2O (WT. %)	P_2O_5 (WT. %)	SrO (WT. %)	Stratigraphic Position Relative to the Palo Pintado San Felipe Boundary (m)	lat	long
AT5-16a	23.80	5.52	33.58	1.13	0.27	1.72	0.10	0.57	0.11	0.02	792	-25.6491	-66.0533
AT6-2	40.84	9.78	20.50	1.48	0.46	2.92	0.07	1.29	0.08	0.02	350	-25.6734	-66.0345
AT4-4	32.43	9.51	24.34	1.35	0.44	3.09	0.14	1.22	0.12	0.02	176	-25.6771	-66.0726
AT2-4d	33.37	8.54	28.18	1.41	0.37	2.78	0.21	0.78	0.23	0.02	84	-25.7309	-66.03
AT4-2	34.93	8.66	25.76	1.28	0.39	2.83	0.27	0.95	0.09	0.02	-147	-25.6761	-66.0766
AT5-4b	32.94	9.45	23.19	1.70	0.35	2.97	0.15	0.93	0.15	0.04	-312	-25.6517	-66.0707
AT7-9	35.37	9.18	25.56	1.53	0.40	3.20	0.08	1.27	0.20	0.03	-336	-25.6743	-66.0779
AT5-3	17.34	5.04	33.60	0.89	0.20	1.67	2.18	0.27	0.11	0.02	-341	-25.6512	-66.0714
AT7-7	25.39	7.33	28.80	1.77	0.30	2.63	1.02	0.53	0.08	0.03	-515	-25.677	-66.081
AT7-6	40.99	9.50	20.14	1.53	0.46	3.30	0.87	1.42	0.15	0.02	-558	-25.6784	-66.0817
AT7-2b	26.98	6.61	29.51	0.98	0.25	2.26	1.02	0.92	4.19	0.03	-948	-25.6752	-66.0864

DATA REPOSITORY TABLE DR4. RODENT INCISOR ENAMEL STABLE ISOTOPE DATA*

Sample-Aliquot	$\delta^{13}C$ (‰)	Estimated Diet d13C	Estimate of %C4	Estimate of %C4 (Arid)	Mean $\delta^{13}C$ (‰)	std. dev. (‰)	$\delta^{18}O$ (‰)	Mean $\delta^{18}0$ (‰)	std. dev. (‰)	Stratigraphic Position Relative to the Palo Pintado San Felipe Boundary (m)	lat	long
AT2-004f-1	-6.55	-17.55	63.9	38.1	-4.18	1.78	-5.22	-4.17	1.15	84	-25.73092	-66.02997
AT2-004g-1	-4.44	-15.44	79.0	54.3			-4.80			84	-25.73092	-66.02997
AT2-004g-2	-3.22	-14.22	87.7	63.7			-4.05			84	-25.73092	-66.02997
AT2-004g-3	-2.49	-13.49	92.9	69.3			-2.60			84	-25.73092	-66.02997
AT5-008-1	-10.15	-21.15	38.2	10.4	-10.60	0.65	-7.87	-7.61	0.37	-75	-25.65211	-66.06724
AT5-008-2	-11.06	-22.06	31.7	3.4			-7.35			-75	-25.65211	-66.06724