Locality	Local Zone	n	age (Ma)	correlation method
Concud Estacion 2	Ki	121	2.54	1
Concud Estacion 1	Ki	199	2.66	1
Escorihuela	MM	295	3.17	1
Escorihuela C	MM	65	3.19	1
Escorihuela B	Do	293	3.21	1
Villalba Alto Rio 4	Do	164	3.69	1
Orrios 3	Do	212	3.72	1
Villalba Alta 2	aM	134	3.74	1
Villalba Alta 4	aM	46	3.96	1
Villalba Alta 1	aM	310	4.01	1
Villalba Alta Rio 3	aM	28	4.05	1
Villalba Alta 3	aM	180	4.08	1
Villalba Alta Rio 2A	aM	62	4.15	1
Villalba Alta Rio 2	aM	213	4.15	1
Villalba Alta Rio 1	Tr	148	4.32	1
Orrios 1	Tr	251	4.39	1
Celadas 6	Tr	33	4.69	4a
Celadas 12	PP-Tr	5	4.84	4a
Celadas 9	PP	100	4.96	4a
Celadas 14	PP	48	5.26	4a
Celadas 5	PP	25	5.26	4a
Celadas 4B	Ce	33	5.35	4a
Celadas 3	Ce	52	5.42	4a
Celadas 8	Ce	63	5.45	4a
Lomas de Casares 2	Ce	256	*5.46*	4a
Lomas de Casares 3	Ce	15	*5.79*	4a
Arquillo 4	M3	40	*5.89*	4b
Celadas 2	M3	156	6.05	4a
Las Casiones sup.	M2	172	*6.27*	4b
Las Casiones	M2	1234	*6.33*	4b
El Bunker 4/5	M1	4	6.48	1
El Bunker	M1	6	6.92	1
Masada del Valle 7	M1	63	6.93	4a
Masada del Valle 6	M1	15	7.00	4a
Concud 3	L	1068	7.10	4c
Los Mansuetos	L	1863	7.10	4c
Concud 2	L	89	7.10	4c
Tortajada	L	88	7.10	4c
Concud Cerro de la Garita	L	248	7.10	4c
Masada del Valle 5	L	390	7.10	4a
Masada del Valle 4	L	39	7.21	4a
Tortajada C/D	L	136	7.26	4a
Masada del Valle 3	L	30	7.31	4a
Tortajada B	L	14	7.54	4a
Masada del Valle 2	L	934	7.60	4a
Tortajada A	K	376	7.91	4c
Alfambra	K	54	7.97	4a

El Bunker 6/7/Valdecebro 4	K	18	8.03	1
Los Aguanaces/ Los Ag. 3A	K	1663	8.13	1
Los Aguanaces	K	123	8.17	1
La Gloria 10	K	150	8.22	1
Puente Minero 3	K	69	*8.39*	3c
Puente Minero	K	1593	*8.51*	3c
Patrimonio Forestal 5/5A	K	12	8.75	2a
Cascante Cubla 2	J4	52	8.80	2a
Peralejos D	J4	135	8.85	2a
Cascante Cubla 1	J4	470	8.90	2a
Peralejos C	J3	356	9.05	2a
Cañizar 6	J3	8	9.07	2c
Puente Minero 13	J3	1	9.21	1
Peralejos B	J3	4	9.25	2a
Masada Ruea 2A	J3	42	9.34	1
Cañizar 4B	J2	2	9.48	1
Puente Minero 10	J2	30	9.49	1
Cañizar 4A	J2	1	9.51	1
Cascante 7/7A	J2	7	9.53	1
Cascante	J2	1	9.53	1
Puente Minero 8	J2	12	9.59	1
Masía del Barbo 2B	J2	425	9.60	1
Masía de la Roma 11	J2	142	9.61	3b
Puente Minero 2	J2	41	9.62	1
Puente Minero 1	J1-2	1	9.70	1
Peralejos 4	J1-2	46	9.71	3a
Masía de la Roma 9	J1	63	9.72	3a
Masía de la Roma 8	J1	18	9.72	3a
Masía del Barbo 2A	J1	138	9.72	3a
Masía de la Roma 7	J1	80	9.74	3a
Masía de la Roma 6	J1	7	9.76	3a
Marinezquita 2/3	J1	14	9.80	1
Cañizar 9	J1	3	9.83	1
Masía de la Roma 5	J1	9	9.84	3a
Masía de la Roma 4C	J1	70	9.85	3a
Masía de la Roma 4B	J1	25	9.87	3a
Pedregueras 2C	I	928	9.94	1
Pedregueras 2A	I	615	10.01	1
Cascante 4	I	9	10.17	1
Nombrevilla 1	H	247	10.76	1
Carrilanga 1	H	646	11.57	2e
Nombrevilla 2	G3	1497	11.69	1
La Solera	G3	1190	*12.01*	2d
Toril 1	G3	738	12.11	2b
Toril 2	G3	314	12.12	2b
Toril 3A	G3	1146	12.13	2b
Toril 3B	G3	1211	12.14	2b
Paje 2	G3	112	12.20	1

Paje 1	G3	161	12.34	1
Las Planas 5H	G3	290	12.57	1
Las Planas 5K	G2	152	13.08	1
Las Planas 5L	G2	159	13.16	1
Las Planas 5C	G1	213	13.55	1
Las Planas 5B	G1	484	13.56	1
Las Umbrias 21	F	977	13.75	1
Las Umbrias 22	F	210	13.76	1
Las Umbrias 20	E	244	13.80	1
Las Planas 4C	E	61	13.88	2c-d
Las Umbrias 19	E	189	13.95	1
Las Planas 4B	E	483	13.96	2c-d
Las Planas 4A	E	95	13.98	2c-d
Las Umbrias 14	E	493	13.99	1
Las Umbrias 18	E	132	14.00	1
Las Umbrias 17	E	142	14.01	1
Las Umbrias 12	E	370	14.03	1
Las Umbrias 16	E	341	14.04	1
Las Umbrias 11	E	626	14.06	1
Las Umbrias 10	Dd	113	14.09	1
Las Umbrias 9	Dd	183	14.18	1
Las Umbrias 8	Dd	396	14.20	1
Las Umbrias 7	Dd	163	14.20	1
Valdemoros 7G	Dd	102	14.24	1
Valdemoros 7F	Dd	272	14.27	1
Valdemoros 7E	Dd	964	14.29	1
Las Umbrias 5	Dd	155	14.30	1
Las Umbrias 4	Dd	470	14.32	1
Valdemoros 7D	Dd	183	14.33	1
Las Umbrias 3	Dd	1124	14.37	1
Vargas 11	Dd	345	14.38	2d
Valdemoros 6B	Dd	177	14.39	1
Las Umbrias 2	Dd	165	14.40	1
Las Umbrias 1	Dd	168	14.42	1
Valdemoros 3F	Dd	272	14.50	1
Valdemoros 3E	Dd	443	14.53	1
Valdemoros 6A	Dd	775	14.53	1
Valdemoros 7C	Dd	1536	14.55	1
Valdemoros 7B	Dd	568	14.59	1
Valdemoros 1A	Dd	192	14.61	1
Valdemoros 7A	Dd	237	14.62	1
Valdemoros 8B	Dd	224	14.67	1
Valdemoros 8C	Dd	127	14.69	1
Vargas 8C	Dd	474	14.71	1
Vargas 8B	Dd	462	14.73	1
Caseton 2B	Dd	342	14.75	2d
Caseton 1A	Dd	991	14.78	2d
Vargas 7	Dd	1160	14.81	1

Valdemoros 3D	Dc	322	14.82	1
Valdemoros 3B	Dc	708	14.84	1
Valdemoros 10	Dc	129	15.20	1
Vargas 6	Dc	468	15.25	1
Vargas 5	Dc	521	15.32	1
Villafeliche 4B	Dc	101	15.49	2c-d
Villafeliche 4A	Dc	595	15.50	2c-d
Valdemoros 8A	Db	770	15.68	2c-d
Moratilla 3	Db	154	15.73	2d
Moratilla 2	Db	1292	15.78	2d
Fuente Sierra 3	Db	307	15.82	1
La Col D	Db	1987	15.84	2c-d
La Col C	Da	2435	15.86	2c-d
La Col B	Da	176	15.88	2c-d
Fuente Sierra 3	Da	346	15.88	1
Fuente Sierra 2	Da	342	15.89	1
Olmo Redondo 8	Da	432	15.91	2c-d
Vargas 2B	Da	435	15.92	1
La Col A	Da	151	15.93	1
Vargas 2A	C	191	15.94	1
Olmo Redondo 7	C	496	15.95	2c-d
Fuente Sierra 1	C	101	15.96	1
Olmo Redondo 4	C	487	15.98	2c-d
Vargas 2	C	636	16.10	1
Vargas 1A	C	1799	16.11	1
Vargas 4BB	C	1463	16.12	1
Vargas 4B	C	280	16.13	1
Vargas 4A	C	1610	16.15	1
Olmo Redondo 4A	C	146	16.30	2b
San Roque 3	C	617	16.33	2b
Artesilla	C	1935	16.49	2b
Villafeliche 2A	B	229	16.63	2b
Olmo Redondo 3	B	119	16.64	2b
San Roque 5	B	128	16.65	2b
San Roque 2	B	869	16.66	2b
San Marco	B	514	16.69	2b
Olmo Redondo 2	B	286	16.72	2b
Olmo Redondo 1	B	177	16.75	2b
San Roque 1	B	904	16.77	2b
San Roque 4B	A	80	16.99	2b
San Roque 4A	A	1100	17.00	2b
Bañon 11A	A	278	*17.45*	5
Bañon 2	A	298	*17.59*	6b
La Dehesa	A	119	*17.95*	6b
Bañon 5	A	131	*17.97*	6b
Ramblar 5	Z	101	*18.02*	6b
Ramblar 7	Z	745	*18.06*	6b
Ramblar 3B	Z	1216	*18.08*	6b

Ramblar 4A	Z	370	*18.13*	6b
Valhondo 3A	Z	189	*18.39*	6b
Valhondo 1	Z	487	*18.59*	6b
Ramblar 1	Z	843	*18.96*	6b
Navarrette del Rio	Z	718	*19.13*	6a
Cabeza Rubia	Y2	194	*19.66*	6a
Alcocer 3B	Y2	358	*19.66*	6a
Atalayuela	Y2	84	*19.63*	6a
Moheda	Y1	335	*20.55*	6a
Buciegas 4B	Y1	164	*21.62*	6a
Valquemado	Y1	239	*20.45*	6a
Vallejo 4	Y1	106	*21.14*	6a
Cetina de Aragon	Y1	720	*21.31*	6a
Moncalvillo	X	582	*22.09*	6a
Sayaton 6	W	140	*22.75*	6a
Parrales	W	109	23.38	1
Sayaton 1	W	85	*23.56*	4b
Hinojosa de Jarque	V-W	229	*23.73*	4b
Canales	V	76	24.28	1
Vivel del Rio	V	2696	24.40	4b

Supplementary Table 1. Localities, local biozones, sample sizes, ages and correlation method. Ages are calibrated to the new 2004 timescale[35,36]. See reference 33 for full names of biozone abbreviations Ce-Ki. (References are included in the Supplementary Notes.) Sample size refers to the number of first and second molars for localities older than 6 Ma, and to the number of first, second and third molars after 6 Ma. Ages in italics are mean values calculated on the basis of 50 equally probable age models calculated by random selection of ages from uncertainty intervals (see Supplementary Notes). Correlation codes: 1, Correlation to local magnetostratigraphically dated section. (Localities positioned in the section or correlated to the section lithostratigraphically on the basis of lateral extension of beds.) 2, Other types of stratigraphical/chronological correlations to local magnetostratigraphy: 2a, Cyclostratigraphical extrapolation. 2b, Lithostratigraphical extrapolation. 2c, Lithostratigraphical interpolation. 2d, Biostratigraphical correlation. 2e, Combined lithostratigraphical - biochronological (morphology-based) correlation. 3, Correlation to intrabasinal magnetostratigraphy: 3a, Use of cyclo- and biostratigraphy. 3b, Use of litho- and biostratigraphy. 3c, Use of lithostratigraphy and biochronology (morphology). 4, Interpolation on the basis of biostratigraphical tie points to both intra- and extrabasinal magnetostratigraphy: 4a, Lithostratigraphical interpolation, 4b, Biostratigraphical interpolation (on the basis of biozone / faunal contents), 4c, Biochronological interpolation (on the basis of morphology). 5, Biostratigraphical correlation (on the basis of faunal contents) to extrabasinal magnetostratigraphy and/or radiometric dating. 6, Constrained interpolation using radiometric and biostratigraphic tie points to intrabasinal magnetostratigraphy and combined extrabasinal magnetostratigraphy/radiometric dating: 6a, Biochronological interpolation (on the basis of morphology), 6b, Lithostratigraphical interpolation using tie-points based on a combination of magnetostratigraphy and radiometric dating on the one hand, and biostratigraphy or biochronology on the other hand.

marine $\delta^{18}O$ events		predicted times of turnover (Fig. 3d, main article)		origination		extinction		turnover	
event	age (Ma)	eccentricity-related (blue areas) (Ma)	obliquity- and eccentricity-related (green areas) (Ma)	age (Ma)	prob.	age (Ma)	prob.	age (Ma)	prob.
100/98[37]	2.41-2.35	2.40-2.35		no data		no data		no data	
G16-10[38]	2.92-2.82	2.82-2.72	2.89-2.85						
M2/MG2[39]	3.37-3.30		3.27-3.12			3.3-3.1	0.99	3.3-3.1	0.92
Gi2/6[39]	3.78-3.66					3.8-3.6	0.91		
		4.39-4.35							
Gi16/18[39]	4.06-4.00		4.12-3.91 4.29-4.26	4.3-4.1	0.98			4.3, 4.1	0.90
Si4/6[38]	4.88-4.82	4.83-4.76							
TG20/22[39]	5.88-5.81		5.51-5.49 5.59	5.9-5.5	0.83	5.4-5.2	0.94	5.4-5.2	0.95
			6.58-6.33						
Tort./Mess. 1,2[40]	7.3-7.2; 7.0-6.9	7.23-7.20		7.2-7.0	0.97	7.2-7.0	0.99	7.2-7.0	1.00
Late Tort.[41]	7.6	7.65-7.63	7.72-7.67 ? 8.08-7.95	7.8-7.7	0.90			7.8-7.7	0.93
Mi7?[41]	8.8		8.95-8.74	9.0-8.7	1.00			8.9-8.8	0.98
Mi7?[41,42]	9.6-9.0: various	9.67-9.63 9.31-9.27		10.0-9.8	0.96	9.8-9.4	0.98	10.0-9.6	0.99
Mi6[41,43,44]	10.45-10.35								
Mi5[41,43,44]	11.8-11.7 / 11.5-11.4								
		12.16-12.10		12.2-12.0	0.99	11.8-11.7	0.95	12.2-12.0	0.98
		12.52-12.48	12.62-12.42						
Mi4[41,43]	13.2 / 12.8								
Mi3B[43,45-47]	13.9-13.8		13.69-13.62	14.3-13.7	1.00	14.1-13.7	1.00	14.3-13.7	1.00
Mi3A[47]	14.2	14.16-14.10		14.3-13.7	1.00	14.1-13.7	1.00	14.3-13.7	1.00
			14.90-14.89 15.02-14.93			14.8-14.7	0.95	14.8-14.7	0.89

Mi2[43,48]	15.9		16.07-16.00 15.89-15.68	15.9-15.8	0.92	16.0-15.8	1.00	16.0-15.8	1.00
				16.7-16.3	0.98			16.6-16.4	0.90
M1b[42,49]	17.4-17.3	19.98-16.94	17.44-17.25	17.1	0.80				
			18.30-18.26 18.22-18.10						
		19.04-18.95							
M1aa[48,49]	19.4		19.47-19.42	*? 19.9-19.7*	*0.59*	*? 19.6-19.3*	*0.70*	*? 19.7-19.3*	*0.62*
			20.68-20.51						
M1a[42,50]	21.15-21.05	21.06-21.00							
		21.42-21.39							
			21.91-21.88	*? 22.3-21.8*	*0.63*	*? 22.2-21.9*	*0.43*	*? 22.2-21.9*	*0.54*
Mi1[43,50]	23.1-23.0					*? 23.5-22.8*			
		23.90-23.82				*? 23.9-23.3*	*0.69*	*? 23.9, 23.5*	*0.58*
			24.34-24.15			24.3	0.82		

Supplementary Table 2. Correlation between major marine benthic stable oxygen isotope events, orbital extremes predicting rodent turnover, and statistically significant rodent turnover peaks. All ages are calibrated to the new 2004 time scale[35,36]. See Supplementary Notes for references 35-50. Predicted times of turnover: mean eccentricity < 0.12 during preceding 100 kyr (left column), and mean 41-kyr obliquity minimum > 0.396 during preceding 400 kyr combined with mean eccentricity < 0.30 during preceding 100 kyr (right column). Ages of origination, extinction and turnover correspond to 0.1-myr units with 3-point moving averages having >80% mean bootstrap probability (see Supplementary Notes). Maximum probabilities for each peak are given. Values in italics correspond to intervals with low (< 80%) probability values, where larger age uncertainties play a role. Possible correlations to oxygen isotope events and/or orbital extremes are indicated for these intervals.