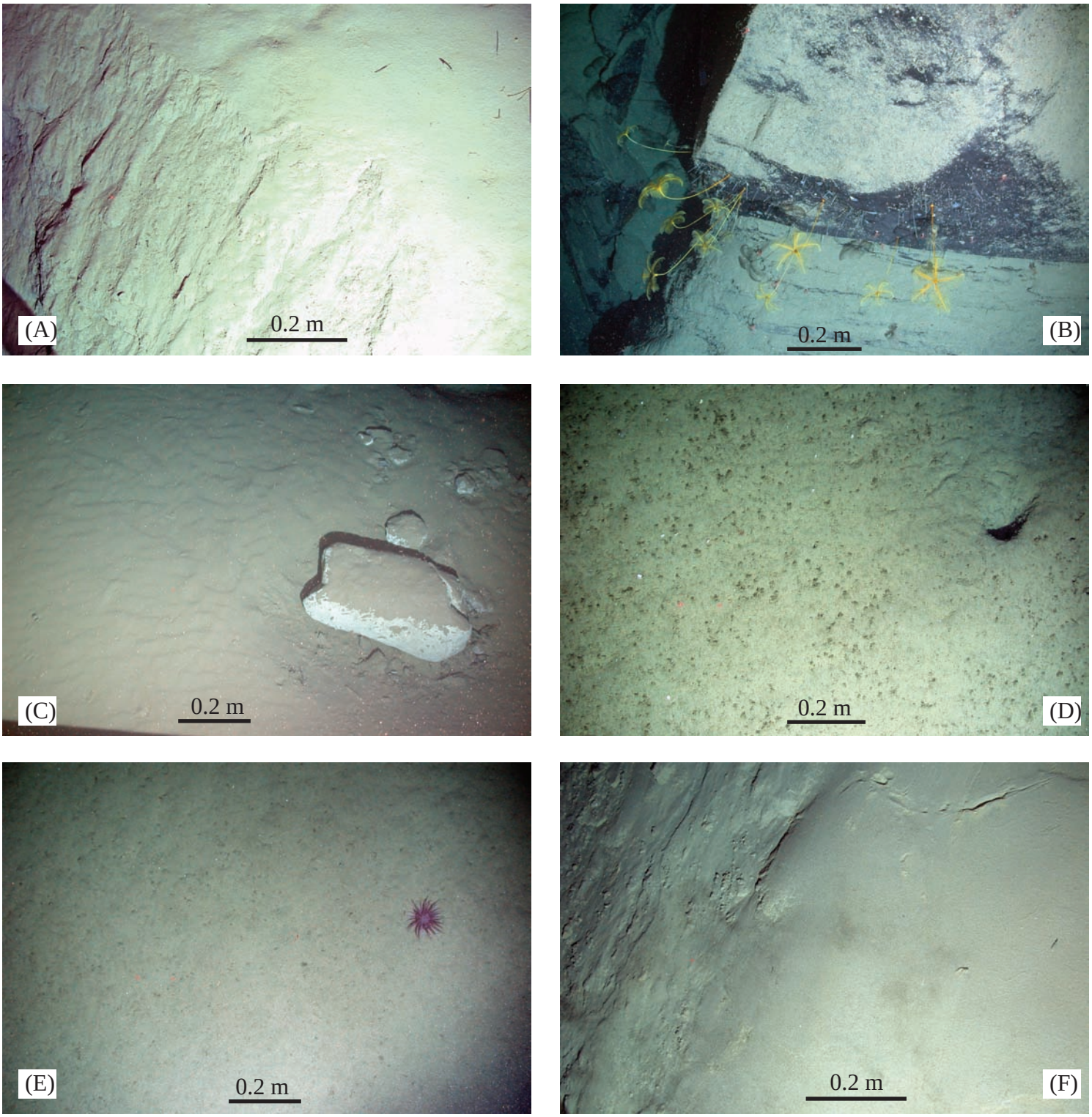
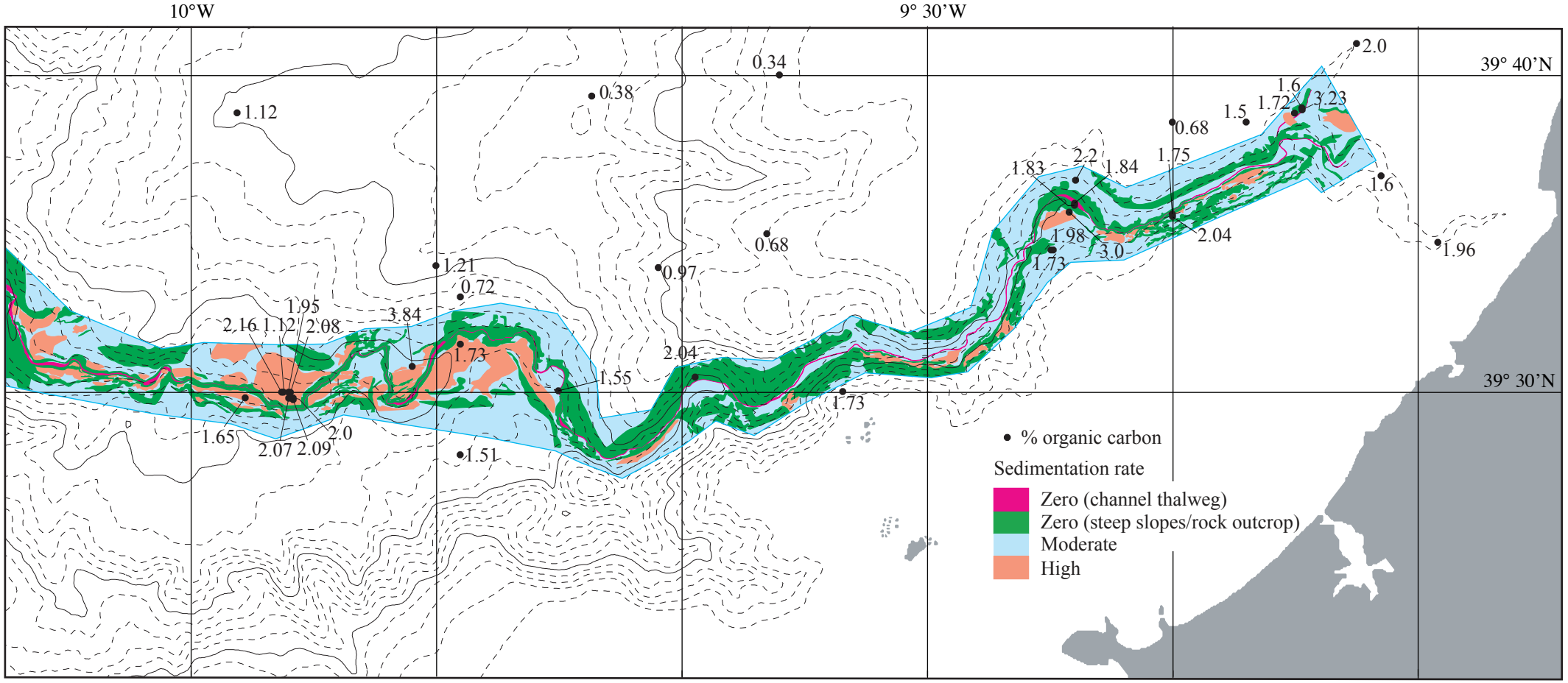
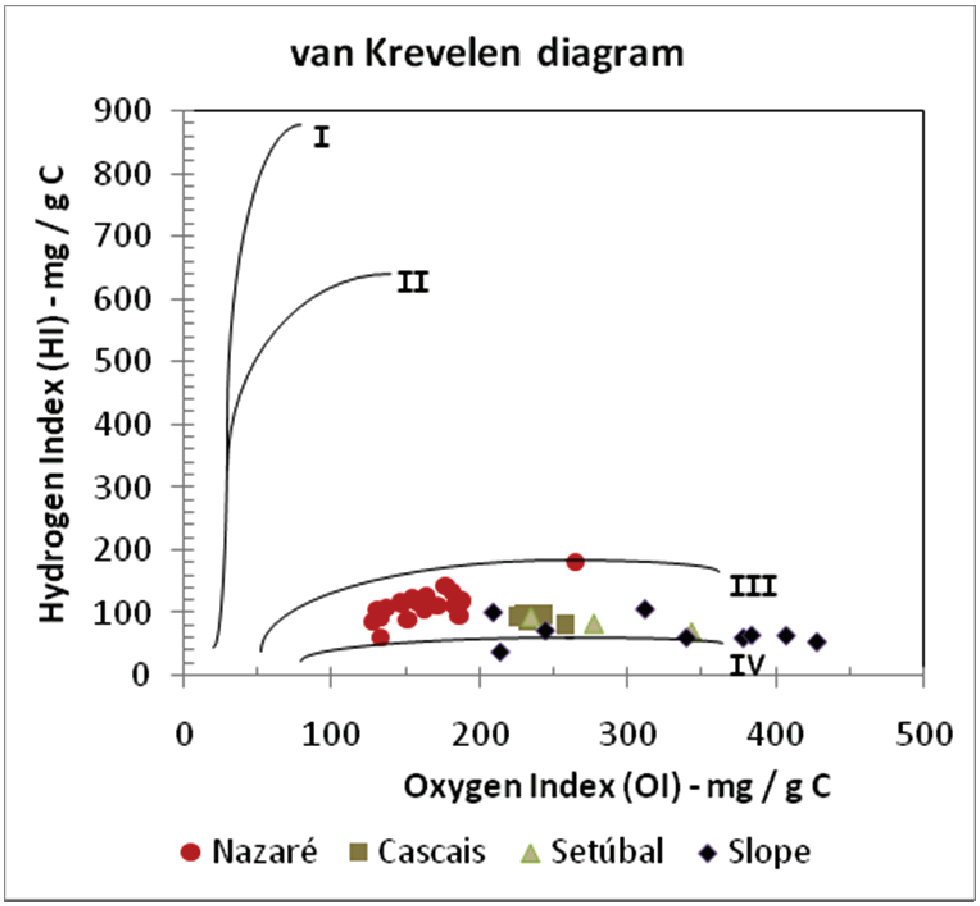


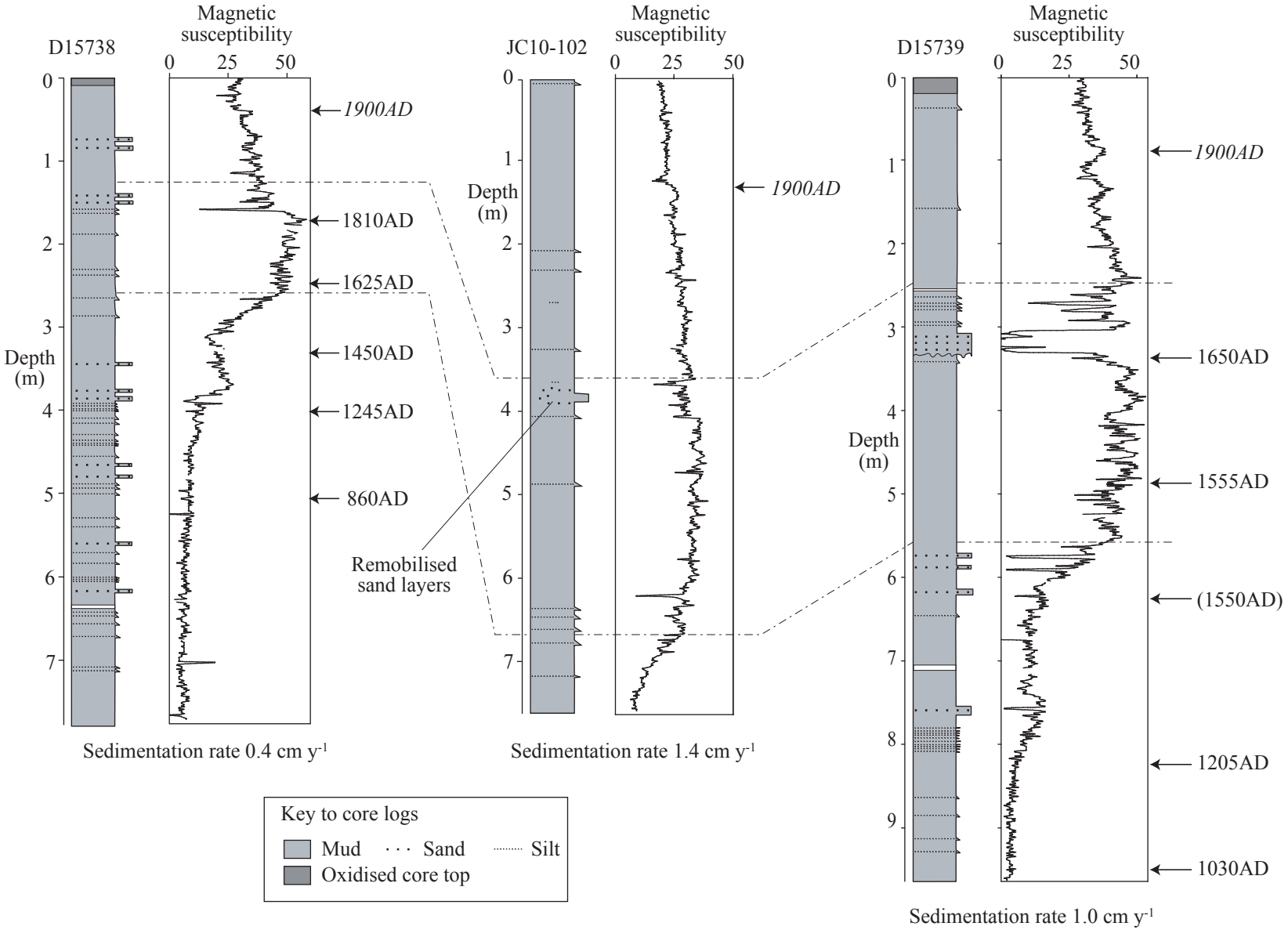
Supplementary Figure 1. Examples of seafloor photographs used to interpret the seafloor sedimentary environment. (a) An abrupt transition between an area of high sedimentation (right) and a steep slope probably resulting from failure of part of the canyon slope (left). The latter clearly corresponds to an area of zero sedimentation. Water depth (WD) 3621 m (b) Rock outcrop (zero sedimentation) exposed on the wall of the inner thalweg. WD 3598 m. (c) A large sand-wave burying rounded boulders on the thalweg floor. This indicates sediment mobility and negligible net accumulation. WD 3657 m (d) and (e) slightly irregular seafloor with common large burrows and epifauna. This is typical of the upper canyon walls and characterises areas of moderate sedimentation. WD 1235 and 1645 m respectively. (f) Area of incipient slope failure suggesting that high sedimentation on steep canyon wall slopes leads to periodic slope failure and remobilisation of sediments. WD 3630 m.



Supplementary Figure 2. Organic carbon (OC) contents of surface sediments plotted on the map of sedimentation rates. The much higher OC content of the canyon sediments is evident.



Supplementary Figure 3. Van Krevelen diagram showing the putative OM (kerogen) types I – IV as determined by Rock-Eval pyrolysis in canyon and slope surficial sediments (0-5 or 0-10 mm) at the Portuguese Margin. OM is dominantly type III, with increasing degree of oxidation (higher OI) from Nazaré to slope sediments (Meyers, 1997; Holtvoeth et al., 2003).



Supplementary Figure 4. Summary of visual core logs, magnetic susceptibility data used for core correlation, dating and sedimentation rate data. Dates are based on AMS ^{14}C (normal text) and ^{210}Pb (italics). Details of AMS dates are given in Supplementary Table 2. Dashed lines show correlation between cores. Cores located on Figure 1.

Supplementary Table 1. Summary of sample locations, carbonate and organic carbon (OC) contents, and sedimentation rates.

Cruise	Station	Location	Latitude	Longitude	Water Depth	Carbonate %	OC %	Sed rate g m^{-2} d^{-1}
JC10	116/PUC01	Nazaré	39° 36.67'N	9° 23.94'W	661	11.2	2.20	
JC10	108/PUC06	Nazaré	39° 29.99'N	9° 33.41'W	1415	13.9	1.73	
JC10	111/PUC01	Nazaré	39° 30.48'N	9° 39.42'W	2195	8.6	2.04	
JC10	131/PUC01	Nazaré	39° 29.82'N	9° 55.84'W	3510	11.0	2.00	
JC10	131/PUC02	Nazaré	39° 29.82'N	9° 55.83'W	3510	12.6	2.09	
JC10	091/PUC01	Nazaré	39° 29.82'N	9° 55.99'W	3535	11.6	2.07	
JC10	102	Nazare	39° 29.72'N	9° 56.07'W	3552			26.3
JC10	103	Nazare	39° 29.92'N	9° 57.50'W	3646			14.4
JC10	128	Nazaré	39° 34.71'N	10° 18.11'W	4365	13.7	1.68	
JC10	136	Open Slope	39° 43.08'N	9° 37.57'W	670	21.8	0.91	
JC10	133	Open Slope	39° 39.33'N	9° 43.65'W	1445	15.0	0.38	
JC10	132	Open Slope	39° 38.79'N	9° 58.12'W	1968	31.9	1.17	
CD179	56851#2	Nazaré	39° 29.99'N	9° 56.01'W	3517	12.7	1.95	
CD179	56856#3	Nazaré	39° 29.98'N	9° 56.00'W	3517	12.1	2.08	
CD179	56847#6	Nazaré	39° 35.57'N	9° 19.99'W	4403	13.3	2.04	
CD179	56859#2	Nazaré	39° 35.59'N	9° 20.00'W	4405	14.7	1.75	
D297	15749#3	Nazaré	39° 34.49'N	9° 24.87’W	720	17.5	1.73	
D297	15749#4	Nazaré	39° 34.49'N	9° 24.91'W	740	12.8	1.98	
D297	15753#2	Nazaré	39° 29.99'N	9° 56.22'W	3425	13.2	2.16	
D297	15753#1	Nazaré	39° 30.02'N	9° 56.19'W	3428	21.1	1.12	
D297	15739#1	Nazare	39° 29.98'N	9° 54.52’W	3432			16.6
D297	15738#2	Nazare	39° 29.81'N	9° 57.77’W	3541		1.65	8.8
D297	15756#1	Nazare	39° 30.54'N	10° 05.42'W	3850			14.1
D297	15758#3	Nazaré	39° 34.98'N	10° 19.04’W	4335	10.0	1.78	
D297	15758#4	Nazaré	39° 35.01'N	10° 19.00’W	4335	12.9	1.54	
D297	15735#2	Nazaré	39° 35.11'N	10° 18.95’W	4336	11.0	1.70	
D297	15735#1	Nazaré	39° 34.99'N	10° 19.16’W	4340	12.7	1.89	
D297	15771#1	Open Slope	40° 35.70’N	10° 22.04’W	3400	48.2	1.21	
D297	15771#2	Open Slope	40° 35.73’N	10° 22.08’W	3400	53.6	0.74	
D297	15771#3	Open Slope	40° 35,74’N	10° 22.09’W	3400	50.9	0.69	
D297	15770#2	Open Slope	40° 04.39'N	10° 21.90’W	4275	39.9	0.70	
D297	15770#3	Open Slope	40° 04.40'N	10° 21.94’W	4275	44.6	0.64	
D297	15770#1	Open Slope	40° 04.40'N	10° 21.91’W	4277	39.1	0.68	
64PE138	12	Nazare	39° 38.9'N	9° 14.7'W	344	9.3	3.23	2.2
64PE138	16	Nazare	39° 35.7'N	9° 24.2'W	890	11.5	3.00	12.9
64PE138	14	Nazare	39° 30.8'N	9° 51.0'W	3097	11	3.84	32.6
64PE138	17	Nazare	39° 34.8'N	10° 16.5'W	4280	12.5	2.12	0.6
64PE138	13	Open slope	39° 38.5'N	9° 20.0'W	137	15.7	0.68	2.2
64PE138	15	Open slope	39° 35.0'N	9° 36.5'W	396	26.1	0.68	
64PE204	57	Nazare	39° 41.00'N	9° 12.49'W	218	11.3	2.00	

64PE204	56	Nazare	39° 38.91'N	9° 14.71'W	338	13.3	1.60	1.8
64PE204	59	Nazare	39° 31.50'N	9° 48.99'W	3008	11.3	1.73	11.6
64PE204	49	Open slope	39° 34.00'N	9° 49.99'W	1881	20.9	1.21	1.0
64PE204	60	Open slope	39° 33.01'N	9° 49.00'W	2323	19.9	0.72	1.5
64PE204	61	Open slope	39° 28.00'N	9° 49.00'W	2467	20.7	1.51	0.9
64PE218	5	Nazare	39° 38.80'N	9° 15.00'W	321	10.3	1.72	14.6
64PE218	4	Nazare	39° 36.82'N	9° 11.49'W	502	9.5	1.60	7.8
64PE218	7	Nazare	39° 54.00'N	11° 10.00'W	4976	22.1	1.47	
64PE218	57	Open slope	39° 38.50'N	9° 16.99'W	151	17.6	1.50	2.9
64PE218	6	Open slope	39° 59.50'N	11° 10.00'W	4806	15.5	0.73	0.3
64PE218	8	Open slope	39° 46.50'N	11° 00.00'W	4806	47.7	0.41	0.1
64PE225	41	Nazare	39° 34.72'N	9° 09.18'W	301	12.8	1.96	46.2
64PE225	26	Nazare	39° 35.97'N	9° 23.98'W	1103	11.2	1.83	
64PE225	34	Nazare	39° 30.05'N	9° 45.00'W	2847	10.3	1.55	
64PE225	24	Nazare	39° 48.04'N	10° 37.98'W	4810	14.6	1.49	
64PE225	22	Nazare	39° 53.92'N	11° 09.39'W	4975	12.4	1.76	0.8
64PE225	39	Open slope	39° 40.00'N	9° 36.00'W	307	16.1	0.34	3.6
64PE225	27	Open slope	39° 33.94'N	9° 40.96'W	1000	29.2	0.97	1.9
64PE225	25	Open slope	39° 46.49'N	10° 00.00'W	4804	45.0	0.62	
64PE236	19	Nazare	39° 41.0'N	9° 12.5'W	215			75.7
64PE236	13	Nazare	39° 35.8'N	9° 24.3'W	941			14.1
64PE236	26	Nazare	39° 36.0'N	9°24.0'W	1103	11.2	1.84	
64PE236	23	Nazare	39° 31.3'N	9° 47.5'W	2850			7.8
64PE236	14	Nazare	39° 30.7'N	9° 51.0'W	3097			16.5
64PE236	15	Nazare	39° 30.2'N	9° 50.6'W	3239			22.1
64PE236	20	Open slope	39° 34.0'N	9° 50.0'W	1884			0.8
64PE236	26	Open slope	39° 28.0'N	9° 56.5'W	2869			0.9
64PE252	27	Open slope	39° 10.36'N	10° 15.22'W	1034	38.9	0.80	
64PE252	26	Open slope	39° 10.76'N	10° 18.84'W	1218	36.9	0.89	
64PE252	17	Open slope	39° 08.95'N	10° 29.97'W	1590	60.0	0.37	
64PE252	16	Open slope	39° 10.60'N	10° 39.97'W	2084	31.1	0.93	
64PE252	15	Open slope	39° 12.28'N	10° 49.99'W	2828	43.0	0.63	
64PE252	14	Open slope	39° 13.74'N	10° 49.99'W	4060	39.5	0.54	
64PE252	13	Open slope	39° 17.29'N	11° 19.98'W	4847	38.3	0.56	

Core	Sample depth (cm)	Sample ID	Conventional ^{14}C age (yr BP)	Error range (± 1σ yr)	Calibration curve	Reservoir age (yr)	Calibrated ^{14}C age range (2σ Cal yr BP)	Average ^{14}C age (Cal yr BP)
D15738	178.5	SUERC-18143	573	37	Marine04	400	90-290	190
	250.5	SUERC-18146	738	37	Marine04	400	290-460	375
	335	SUERC-18147	934	37	Marine04	400	480-620	550
	405	SUERC-18148	1204	37	Marine04	400	660-850	755
	509.5	SUERC-18149	1482	35	Marine04	400	940-1130	1035
D15739	334.5	SUERC-18150	703	37	Marine04	400	270-435	352
	489.5	SUERC-18151	821	37	Marine04	400	370-520	445
	628	SUERC-18152	816	37	Marine04	400	360-520	440
	829.5	SUERC-18153	1245	37	Marine04	400	700-890	795
	959.5	SUERC-18156	1411	37	Marine04	400	890-1050	970

Supplementary Table 2. Details of radiocarbon dates used to determine sedimentation rates in cores D15738 and D15739 (see Supplementary Figure 4). Cores located on Figure 1c.