Supplementary Table 1

Sample	Depth (m)	δ^{13}C‰ (PDB)	δ^{18}O‰ (PDB)	% Mg-Calcite	% Aragonite	% Calcite
RR 1/1	0.00	1.44	-1.61	100		
RR 2/12	0.85	1.37	-2.75	30	70	
RR 4/2	1.69	1.55	-2.05	41	59	
RR 1/3	4.06	1.69	-0.91	82	18	
RR 5/4	4.92	0.42	-2.77	14	86	
RR 1/4	5.18	0.00	-4.18		100	
RR 5/11	7.13	-0.17	-3.37		100	
RR 5/5	7.66	0.33	-3.93		100	
RR 5/1	8.28	-2.90	-4.07	13	87	
RR 7/4	10.29	1.11	-1.71	20	80	
RR 7/3	10.45	1.58	-2.80	7	93	
RR 7/2	10.50	1.59	-2.76	5	95	
RR 7/1	10.56	0.92	-2.05	4	56	
RR 8/4	12.85	-0.44	-2.89	6	94	
RR 8/3	12.92	1.44	-3.28	12	88	
RR 8/1	13.11	1.34	-2.66	11	89	
RR 9/10	15.85	-5.26	-5.69			100
RR 9/9	16.10	-7.76	-6.24	100		
RR 9/8-1	16.27	-5.83	-5.64		4	96
RR 9/8-2	16.57	-6.47	-6.20			100
RR 9/6	16.58	-6.65	-6.28			100
RR 9/6	16.93	-4.90	-5.72			100
RR 9/5	16.94	-6.10	-6.64			100
RR 9/3	17.03	-4.72	-6.25			100
RR 9/1	17.56	-6.37	-6.43			100
RR 10/15	18.91	-4.59	-6.47			100
RR 10/12-1	19.30	-3.80	-6.15			100
RR 10/12-2	19.50	-4.55	-5.87			100
RR 10/8	19.95	-3.77	-5.90			100
RR 10/4	20.95	-4.57	-6.29			100
RR 10/1	21.34	-4.09	-6.15			100
RR 11/4	23.91	-2.29	-6.44			100
RR 11/3	24.12	-4.61	-6.67			100
RR 11/2	24.23	-5.58	-6.71			100
RR 11/1	24.36	-5.02	-6.34			
RR 12/4	24.85	-3.80	-6.81			
RR 12/3	24.95	-3.61	-8.55			100
RR 12/2	25.05	-5.49	-6.62			
RR 12/1	25.18	-0.41	-6.51			100
RR 13/13	27.91	-7.60	-8.12			100
RR 13/9	28.26	-7.34	-6.30			
RR 13/6	28.49	-6.76	-6.35			
RR 13/4	28.78	-5.57	-6.10			
RR 14/3	30.85	-4.76	-6.05			
RR 15/9	31.65	-0.18	-6.01			100

RR 16/11	33.90	-6.83	-7.60	100
RR 16/4	34.81	-7.08	-6.38	
RR 16/2	35.33	-5.11	-6.72	
RR 18/12	36.90	-6.43	-5.93	
RR 19/9	37.79	-6.92	-6.04	
RR 18/7	38.42	-7.87	-6.27	
RR 19/10	40.30	-7.88	-7.97	
RR 20/9-1	43.64	-4.26	-6.45	
RR 20/9-2	43.89	-5.87	-5.91	
RR 21/14	46.00	-5.23	-6.02	
RR 21/11	46.42	-5.70	-8.03	100
RR 21/5	47.92	-10.28	-6.17	100
RR 21/1	48.96	-5.95	-9.28	
RR 22/4	49.96	-3.97	-6.15	
RR 22/2	50.48	-4.42	-5.92	
RR 22/1	50.60	-6.20	-5.72	
RR 23/3	51.35	-3.93	-6.07	
RR 23/2	51.45	-3.72	-6.02	
RR 23/1	51.55	-3.93	-5.90	
RR 23/3	51.85	-4.29	-5.81	
RR 24/2	52.00	-3.47	-6.05	
RR 25/9	52.90	-3.99	-5.88	
RR 25/8	53.00	-4.87	-5.95	100
RR 25/6	53.10	-6.50	-5.85	
RR 25/1	53.69	-3.59	-6.32	
RR 26/6	55.05	-3.79	-5.84	
RR 26/2	55.59	-5.42	-6.04	
RR 27/7	59.37	-3.78	-5.85	
RR 28/1	60.85	-3.98	-6.30	
RR 29/10	61.29	-5.84	-6.02	
RR 29/6	61.70	-4.87	-5.95	
RR 29/4	62.08	-6.21	-5.36	
RR 29/1	62.57	-5.07	-6.48	
RR 30/6	62.60	-5.56	-6.02	
RR 30/1	63.28	-5.48	-6.52	
RR 31/4	64.01	-7.12	-6.62	
RR 31/2	64.35	-6.48	-6.46	
RR 32/10	65.15	-6.34	-5.94	
RR 32/6	65.99	-4.90	-6.57	
RR 32/2	66.50	-5.94	-6.53	
RR 33/14	66.94	-7.25	-6.19	
RR 33/13	67.05	-5.96	-6.29	
RR 33/10	67.43	-6.12	-6.29	
RR 33/9	67.55	-6.13	-5.97	
RR 33/5	68.14	-6.01	-5.58	
RR 33/3	68.45	-6.49	-5.54	
RR 34/2	69.39	-5.36	-5.73	
RR 35/1	70.63	-5.06	-5.52	
RR 36/2	71.75	-6.11	-5.79	

RR 38/9	74.43	-2.19	-5.53	100
RR 38/5	74.73	-3.25	-5.18	
RR 39/8	75.85	-3.19	-5.39	
RR 39/1	77.02	-5.33	-4.98	
RR 40/5	78.85	-5.78	-5.54	
RR 40/4	78.95	-6.51	-5.92	
RR 41/14	79.64	-3.93	-5.48	
RR 41/10	80.13	-4.90	-5.29	
RR 41/1	81.49	-4.82	-5.67	
RR 42/15	81.85	-4.06	-5.59	
RR 42/5	83.99	-3.41	-5.78	
RR 42/4	84.22	-4.94	-5.98	
RR 42/1	84.78	-3.65	-5.43	
RR 43/3	84.90	-7.12	-5.81	
RR 45/12	87.85	-3.50	-5.91	
RR 45/5	88.99	-3.69	-5.96	
RR 46/3	91.05	-5.13	-5.79	
RR 47/7	92.25	-5.99	-5.56	
RR 47/3	92.93	-5.59	-5.57	
RR 48/10	93.69	-4.24	-5.87	
RR 48/6	94.40	-3.21	-5.92	
RR 48/1	95.16	-5.62	-4.63	
RR 50/1	97.59	-4.67	-4.55	
RR 51/8	97.70	-4.34	-4.96	
RR 51/6	98.03	-4.99	-4.93	
RR 52/2	99.46	-5.04	-4.87	
RR 53/14	99.85	-5.69	-4.54	
RR 53/13	99.97	-4.77	-5.12	
RR 53/7	101.08	-4.47	-4.51	
RR 53/1	102.89	-6.06	-4.93	
RR 54/8	104.03	-5.79	-4.41	
RR 54/6	104.38	-5.44	-5.06	
RR 54/2	104.80	-5.55	-4.42	
RR 55/5	105.39	-5.65	-5.15	
RR 55/3	105.69	-5.47	-4.48	
RR 55/1	105.88	-5.79	-5.13	
RR 56/15	106.86	-4.99	-4.77	
RR 56/8	108.06	-4.56	-5.03	
RR 56/6	108.22	-4.30	-4.76	
RR 56/1	108.90	-4.63	-4.97	
RR 57/13-1	108.97	-5.15	-4.57	
RR 57/13-2	109.30	-3.79	-5.53	
RR 57/7	110.86	-4.33	-4.53	
RR 57/5	111.07	-4.55	-5.19	
RR 58/1	111.72	-4.77	-4.66	
RR 59/13	112.07	-4.86	-5.32	
RR 59/9	112.79	-4.56	-4.66	
RR 59/6	113.27	-4.95	-5.47	
RR 59/3	113.59	-4.28	-4.63	

RR 59/1	114.07	-4.44	-4.69	100
RR 60/3	114.15	-4.47	-4.99	
RR 60/1	114.34	-4.57	-4.56	
RR 61/3	114.40	-4.47	-4.99	
RR 62/16	114.92	-3.76	-5.18	
RR 62/12	115.64	-4.87	-4.79	
RR 62/10	116.09	-4.57	-4.97	
RR 62/7-1	116.72	-3.54	-4.99	
RR 62/7-2	116.88	-3.59	-5.34	
RR 63/7	117.85	-2.59	-4.94	
RR 63/5	118.16	-2.23	-5.16	
RR 63/2	118.60	-3.61	-5.50	
RR 64/1	119.39	-3.13	-5.38	
RR 65/1	120.23	-1.20	-5.25	
RR 66/3	121.02	-1.94	-5.73	
RR 66/1	121.33	-4.80	-4.75	
RR 67/3	121.70	-3.72	-5.26	
RR 68/5	122.65	-4.91	-5.02	
RR 69/1	123.60	-4.35	-5.67	
RR 70/5	124.11	-5.43	-4.93	
RR 71/5	125.68	-5.73	-5.78	
RR 72/3	127.14	-2.75	-5.20	
RR 72/2	127.26	-3.19	-5.45	
RR 73/2	128.20	-4.87	-7.76	100
RR 74/6	128.79	-3.70	-5.44	
RR 74/2	129.42	-5.97	-6.43	
RR 75/1	130.83	-5.00	-6.38	
RR 76/7	131.35	-5.32	-5.47	
RR 76/4	131.77	-4.81	-5.90	
RR 76/3	131.90	-3.54	-5.63	
RR 77/4	133.30	-4.92	-5.90	
RR 79/1	135.85	-4.75	-5.63	
RR 81/6	136.59	-0.78	-6.14	100
RR 81/4	136.84	-3.79	-5.36	
RR 82/5	138.00	-3.64	-5.60	
RR 83/3	139.42	-2.93	-5.63	
RR 83/1	139.61	-2.83	-5.65	
RR 85/2	141.95	-3.64	-5.60	
RR 86/1	142.17	-2.62	-5.29	100
RR 87/3	142.35	-2.68	-5.32	
RR 88/1	143.85	-4.52	-6.67	100
RR 89/1	144.00	-2.46	-5.75	
RR 92/7	145.65	-2.63	-5.68	
RR 92/4	146.07	-2.58	-5.40	
RR 92/1	146.45	-1.98	-5.72	
RR 93/4	146.96	-2.77	-5.74	
RR 94/6	148.15	-1.94	-5.93	
RR 94/2	148.66	-2.44	-5.21	
RR 95/5	148.85	-1.31	-5.28	

RR 95/1	149.44	-2.18	-5.23		
RR 97/2	151.00	-1.91	-5.66		100
RR 98/4	151.98	-1.23	-5.50		
RR 99/2	152.85	-5.50	-6.70		100
RR 100/3	152.85	-1.55	-6.30		
RR 104/14	154.25	-0.28	-4.32		
RR 104/11	158.83	-0.64	-4.33		
RR 104/8	159.46	-0.01	-3.47		
RR 104/1	160.46	-0.29	-4.98		
RR 105/1	162.54	-2.09	-5.02		
RR 106/2	163.28	-1.42	-4.63		
RR 107/1	163.85	-1.91	-4.47		
RR 109/3	169.46	0.22	-3.33		
RR 110/1	171.85	-1.19	-3.91		100
RR 112/7	175.51	0.75	-4.67		
RR 112/3	175.66	0.12	-5.17		
RR 113/4	177.85	0.42	-4.22		
RR 113/2	178.14	0.29	-3.97		
RR 114/2-1	181.25	0.34	-3.23		
RR 114/2-2	181.50	-0.26	-4.53		
RR 115/6	184.17	2.55	-0.08	37	63
RR 116/8	185.24	0.24	-3.93		
RR 117/11	187.05	-0.35	-4.70		
RR 117/5	187.79	-0.15	-4.64		
RR 118/3	190.18	0.63	-4.07		
RR 118/1	190.41	-0.09	-5.41		
RR 119/2	193.25	0.37	-3.97		
RR 119/1	193.37	-1.83	-5.82	23	77
RR 120/5	195.85	0.12	-3.93		
RR 120/2	196.09	-0.42	-4.59	15	85
RR 120/1	196.21	0.20	-3.38		
RR 121/11	198.85	2.42	-0.49		
RR 121/9	199.22	2.51	-0.37		
RR 121/7	199.43	2.11	-0.37		
RR 121/5	199.55	2.39	0.12	13	87
RR 121/3	199.78	2.39	0.06		
RR 121/1	199.99	2.56	0.35		
RR 124/4	204.00	2.47	-0.47		
RR 124/1	205.09	2.53	-0.08		
RR 125/10	207.95	1.22	-1.87		
RR 125/2	208.98	2.83	0.20	49	51
RR 125/1	209.14	2.67	-0.09	22	78

Supplementary Table 2

Sample	Depth (m)	$\delta^{13}C$ (PDB)	$\delta^{18}O$ (PDB)	$^{87}Sr/^{86}Sr$	±2SE	Description
RIBBON REEF SR-ISOTOPE STRATIGRAPHY						
RR 45/9 2-6 (1)	88.49	-	-	0.709148	0.000016	coral
RR 59/4 16-18 (1)	113.66	-	-	0.709148	0.000017	coral
RR 68/7 14-18 (1)	122.48	-	-	0.709148	0.000016	coral
RR 125/7 0-4 (1)	208.40	-	-	0.709144	0.000018	sediment
RR 125/6 2-6 (1)	208.53	-	-	0.709144	0.000017	sediment
RR 125/5 9-13	208.73	-	-	0.709140	0.000016	sediment
RR 125/4 10-15 (1)	208.90	-	-	0.709134	0.000016	coral
RR 125/2 0-4 (1)	209.16	-	-	0.709134	0.000016	sediment
RIBBON REEF TEST FOR THE IMPACT OF DIAGENESIS ON SR-ISOTOPE DATING						
RR 2/7 14-18 (1)	2.35	0.02	-4.13	0.709174	0.000009	coral
RR 4/6 0-4 (1)	5.50	-0.88	-6.41	0.709179	0.000010	coral
RR 15/3 21-26 (1)	33.21	-10.37	-6.34	0.709202	0.000010	cement
RR 15/3 21-26 (2)	33.21	-6.54	-6.69	0.709192	0.000023	coral
RR 16/4 0-6 (1)	35.21	-10.48	-6.07	N/A	N/A	cement
RR 16/4 0-6 (2)	35.21	-5.17	-7.33	0.709178	0.000009	coral
RR 19/5 7-12 (1)	42.70	-6.17	-6.83	0.709166	0.000009	coral
RR 19/5 7-12 (2)	42.70	-12.14	-6.90	0.709157	0.000011	cement
BOULDER REEF SILICLASTICS						
BR PW 1	54.00	-	-	N/A	N/A	pore water
BR PW 2-3	45.00	-	-	0.709189	0.000016	pore water
BR PW 4	50.00	-	-	0.709186	0.000017	pore water
BR PW 5	50.00	-	-	0.709200	0.000016	pore water
BR PW 6-7	11.00	-	-	0.709172	0.000017	pore water
BR PW 8-9	27.45	-	-	0.709209	0.000017	pore water
BR PW 10-12	37.00	-	-	0.709186	0.000016	pore water
BR PW 13-16	56.00	-	-	0.709200	0.000017	pore water
BR PW 17-20	41.00	-	-	0.709224	0.000016	pore water
BR PW 20-22	69.00	-	-	0.709120	0.000014	pore water
BR PW 24-26	81.00	-	-	0.709109	0.000016	pore water
MODERN SEAWATER				0.709182	0.000020	
MAINLAND LOCAL RIVERWATER				0.710390	0.000020	

Supplementary Table 3

Sample	Depth (m)	Inc (deg)	Int (mA/m)	Polarity
RR 2/3	3.33	-30.0	0.4	N
RR 5/2	9.37	13.9	0.2	R*
RR 9/8	16.55	-40.1	1.2	N
RR 10/6	20.67	22.0	0.5	R*
RR 11/9	23.40	-36.6	0.2	N
RR 13/3	30.74	-34.9	0.3	N
RR 16/10	36.29	-34.4	0.3	N
RR 17/3	36.42	-43.6	0.4	N
RR 19/8	41.39	-30.9	0.3	N
RR 19/6	41.80	-36.7	0.3	N
RR 20/7	44.34	-30.5	0.2	N
RR 21/2	48.59	-22.5	1.1	N
RR 21/1	48.89	-22.5	0.5	N
RR 27/1B	60.68	down	2.4	?
RR 27/13	58.25	-35.9	1.6	N
RR 29/4	62.21	39.4	6.7	?
RR 30/1	63.82	-34.0	0.1	N
RR 32/13	65.15	-26.6	2.0	N
RR 32/10	65.63	-37.1	1.2	N
RR 33/8	68.19	-38.7	1.1	N
RR 37/2	73.88	-42.0	0.0	N
RR 42/12	82.42	-22.5	0.4	N
RR 44/8	86.44	up	0.1	N
RR 44/6	86.74	-40.0	2.0	N
RR 45/11	88.29	27.3	4.1	R*
RR 49/1	96.74	-41.3	0.4	N
RR 53/3	102.43	-33.2	0.6	N
RR 57/12	109.73	-24.5	2.0	N
RR 57/11	110.19	up	2.9	N
RR 57/6	111.15	-29.0	2.0	N
RR 59/12	112.45	-33.4	1.5	N
RR 61/1	114.76	-6.0	4.8	N
RR 62/5	117.50	-11.3	0.1	N
RR 63/2	118.82	-30.0	6.1	N
RR 70/5	124.36	-24.1	0.1	N
RR 81/4	137.08	23.9	0.1	R*
RR 83/6	139.39	8.4	0.0	R*
RR 104/10	161.20	-40.0	0.4	N
RR 104/5	162.16	-50.0	0.1	N
RR 105/3	162.79	-30.0	2.0	N
RR 106/4	163.14	up	0.3	N
RR 115/4	184.65	-5.1	0.2	N

N= normal; R*= reversed, interpreted as resulting from samples inadvertently inverted during drilling.

Supplementary Table 1. Stable isotope data used in Figures 2 and 3 and X-ray diffraction mineral data (Ribbon Reef 5 borehole).

Supplementary Table 2. Strontium isotope data used to date the sequence recovered from the Ribbon Reef 5 borehole (Fig. 3). Geochemical data are also shown for microsampled separates of coral and cement from near the top of this borehole and for pore fluids from siliciclastic units in the Boulder Reef borehole. Although the Boulder Reef pore-water samples come from siliclastic sediments, they have $^{87}Sr/^{86}Sr$ values that are dominated by the influence of modern seawater. Furthermore, despite significant stable isotope differences, the coral and cement pairs from near the top of the Ribbon Reef 5 borehole have $^{87}Sr/^{86}Sr$ values that are indistinguishable from each other and modern seawater. These data highlight the fact that Sr-isotope dating systematics (unlike U-series) are robust in offshore carbonate sequences such as Ribbon Reef 5 even when subjected to extreme diagenetic alteration because these sequences are generally remote from sources of radiogenic Sr (Ludwig et al., 1988; Quinn et al., 1991; Ohde and Elderfield, 1992; Aharon et al., 1993; Wilson et al., 1998; see Methods).

Supplementary Table 3. Paleomagnetic data used in Figure 3. Thirty five samples (the great majority) were of normal polarity whereas five were reversed and two of intermediate polarity. We interpret the whole sequence as being Brühnes age (<790 ka) and the few reversed magnetizations as resulting from samples that were either reworked downslope by storm activity after the primary remanence had been locked in or were inadvertently inverted during drilling/curation. The average inclination of -31° is very close to –29°, the inclination expected for an axial geocentric dipole of normal polarity.