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Supplement of

Subaqueous speleothems (Hells Bells) formed by the interplay of pelagic redoxcline biogeochemistry and specific hydraulic conditions in the El Zapote sinkhole, Yucatán Peninsula, Mexico

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Supplement to "Subaqueous speleothems (Hells Bells) formed by the interplay of pelagic redoxcline biogeochemistry and specific hydraulic conditions in the El Zapote sinkhole, Yucatán Peninsula, Mexico".

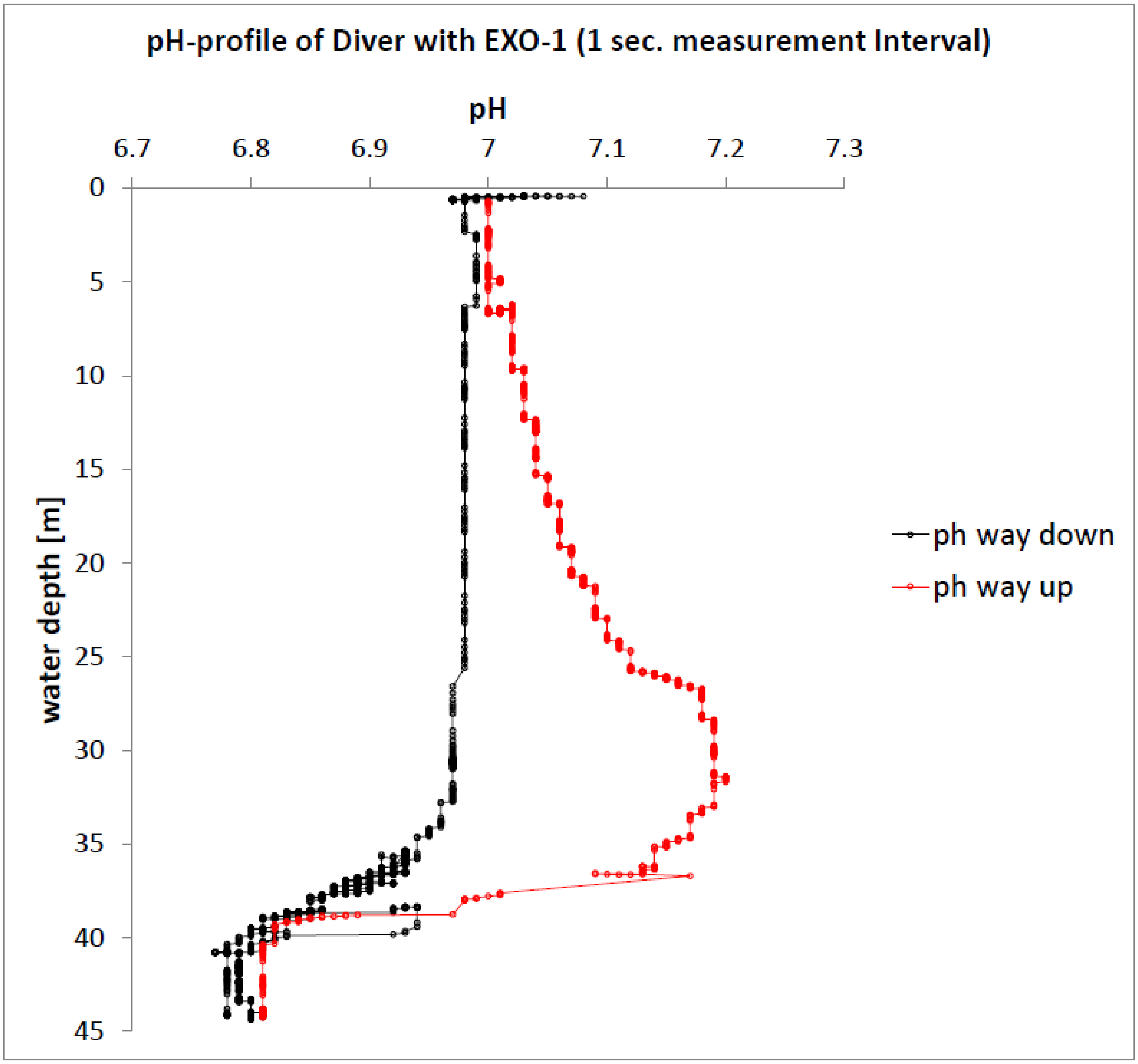

Fig. S1: pH-logs of EXO-1 probe deployed at a dive down to 45 m water depth. The probe was attached to the gas bottle of a technical diver and pH was logged every second. The pH-electrode reacted on elevated sulfide concentrations below 36 m water depth resulting in higher pH readings. This is evident in the pH readings on the way up that are elevated compared the readings on the way down. However, the probe seems to regenerate itself in some time after the exposure to sulfide.

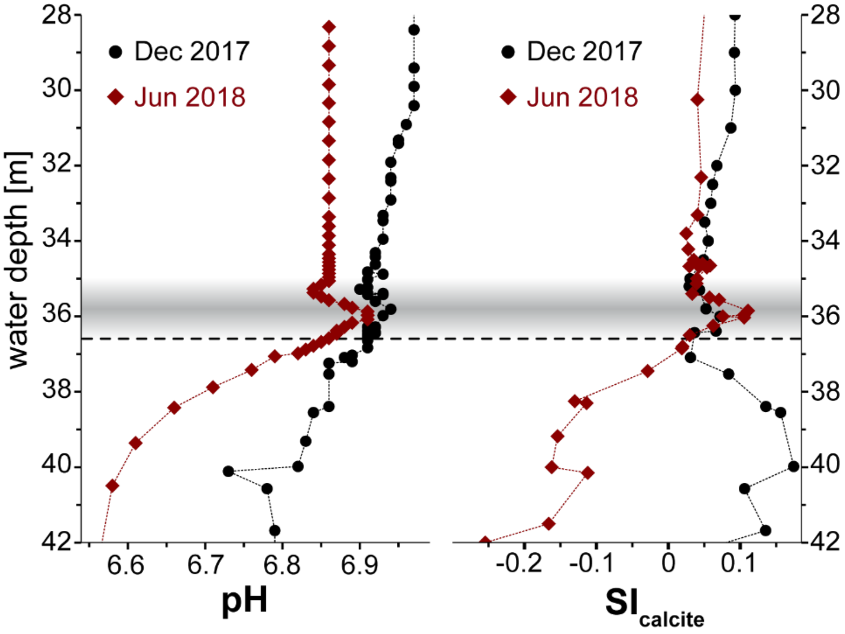

Fig. S2: pH values and calculated saturation indices for calcite at different water depths of the two sampling campaigns in December 2017 and June 2018. Note the distinct peak of calcite oversaturation at ~35.8 m water depth and the difference of pH and SI values below the turbid layer (grey band), which is due to a non-quantifiable positive pH shift in the measurement of December 2017 (see also Fig. S1).

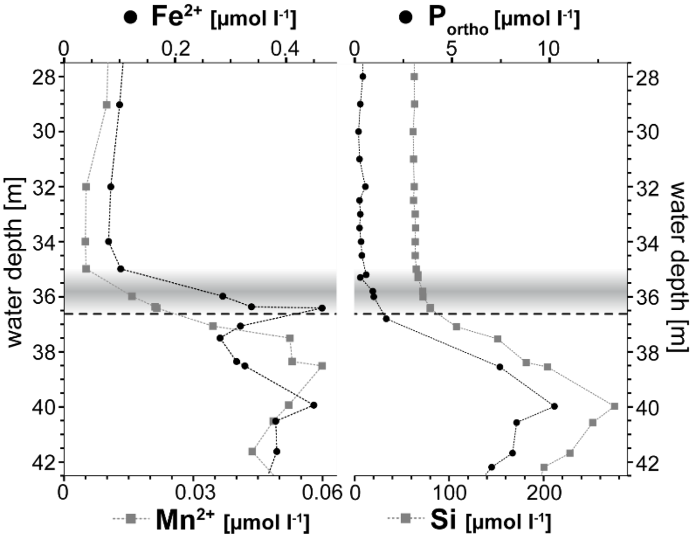

Fig. S3: Concentrations of dissolved iron and manganese (left) and orthophosphate and silica (right) in 28–42 m water depth. The grey band represents the turbid layer in 35–36.6 m water depth and the dashed line indicates the top of the halocline at 36.6 m water depth.

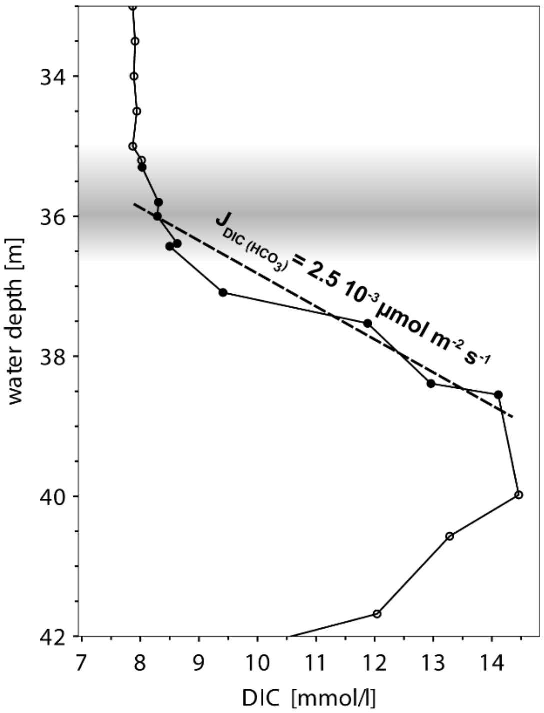

Fig. S4:Concentration of DIC with water depth at El Zapote cenote. The flux of DIC towards the redoxcline was calculated after Fick´s first law using the diffusion coefficient of HCO_3^- from the linear regression of the data points indicated by a full circle.

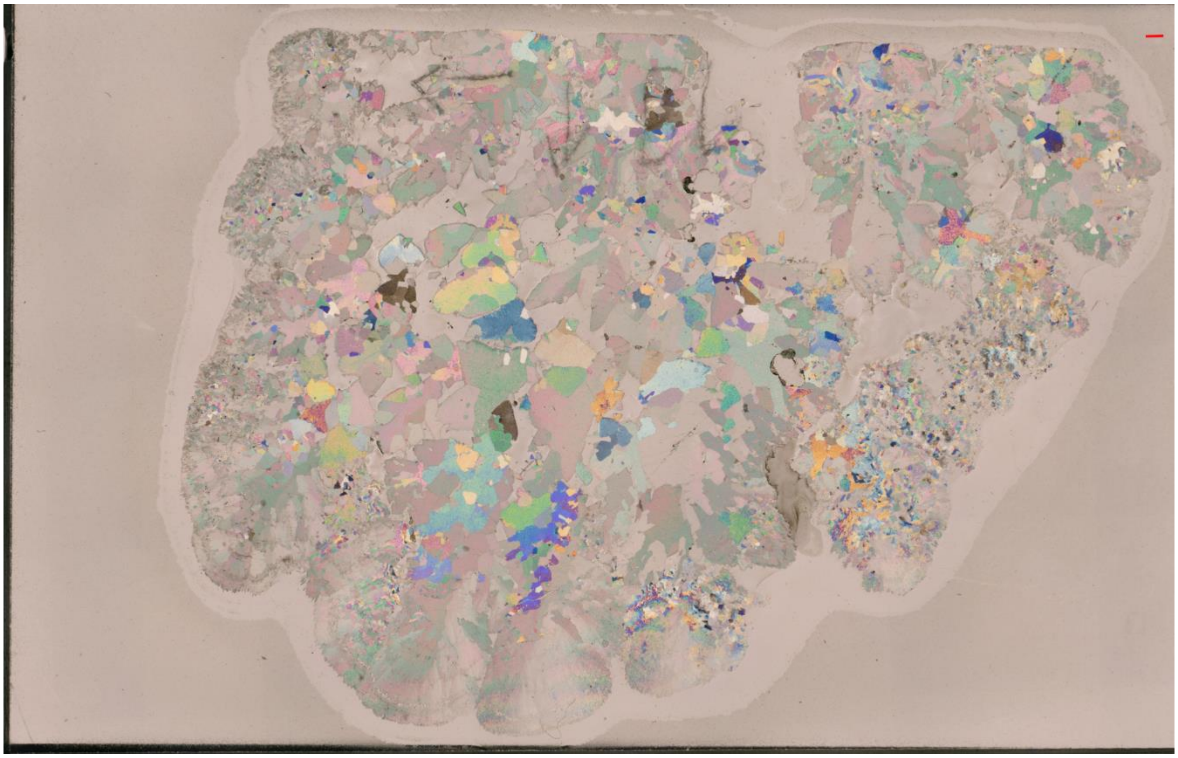

Fig. S5: Polarized-light microscopic image (crossed polarizers) of a thin section of the lowermost part of ZPT-7. The red scale bar on the upper right are 500 µm. Note the two different calcite phases of mosaic or blocky calcites in the upper part and botryoidal fan-like calcite needles in the lower part of the thin section. Note the strong resemblance of the botryoidal calcites in the lower part to the macroscopic shape of the conical Hells Bells.

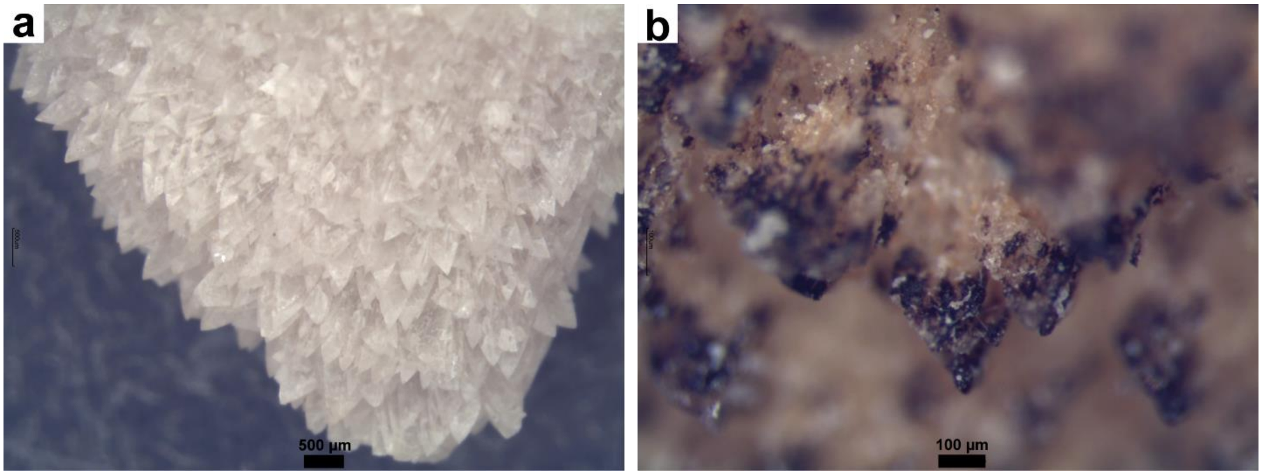

Fig. S6: Light microscopic images of Hells Bells calcite needles of clear white Hells Bells found below ~30 m water depth and with brownish Mn-oxide coatings on Hells Bells from 28–30 m water.

Table S1: In-Situ parameter readings from EXO-1 probe. Given values represent the last values of measuring >1 min at a certain water depth.

In-Situ Parameters readings (EXO-1)

Profile - type	date [d.m.y]	water depth [m]	sp. Conductivity µS/cm	O2 mg/l	Turbidity FNU	pH	Temp °C	EH mV
winch profile 1	11.12.2017	11.69	1435	3.85	-0.21	6.97	24.373	221.8
winch profile 1	11.12.2017	21.23	1441.2	3.8	-0.2	6.97	24.404	232.4
winch profile 1	11.12.2017	26.25	1441.5	3.76	-0.21	6.97	24.411	238
winch profile 1	11.12.2017	32.32	1583.2	2.33	-0.19	6.94	24.553	242.1
winch profile 1	11.12.2017	33.32	1624.2	1.94	-0.18	6.93	24.573	242
winch profile 1	11.12.2017	34.31	1695.8	1.11	-0.16	6.92	24.598	240.3
winch profile 1	11.12.2017	35.28	1803.9	<0.2	1.1	6.9	24.626	236.8
winch profile 1	11.12.2017	36.28	2276.9	<0.2	1.36	6.91	24.668	54.2
winch profile 1	11.12.2017	37.24	5398	<0.2	-0.06	6.86	24.718	-41.8
winch profile 2	11.12.2017	0.47	1436.3	4	-0.16	6.97	24.373	262.8
winch profile 2	11.12.2017	28.40	1446.7	3.69	-0.21	6.97	24.412	267.4
winch profile 2	11.12.2017	29.41	1445.7	3.74	-0.21	6.97	24.418	269.9
winch profile 2	11.12.2017	29.90	1446	3.73	-0.21	6.97	24.416	271.4
winch profile 2	11.12.2017	30.41	1452.1	3.64	-0.17	6.97	24.436	272.3
winch profile 2	11.12.2017	30.91	1488.6	3.33	-0.23	6.96	24.485	273.1
winch profile 2	11.12.2017	31.32	1523.6	2.99	-0.21	6.95	24.498	241.5
winch profile 2	11.12.2017	31.41	1541.1	2.86	-0.22	6.95	24.535	273.5
winch profile 2	11.12.2017	31.91	1578.5	2.52	-0.15	6.94	24.55	273.6
winch profile 2	11.12.2017	32.41	1591.1	2.39	-0.23	6.94	24.558	273.4
winch profile 2	11.12.2017	32.91	1612.8	2.09	-0.24	6.94	24.57	273.1
winch profile 2	11.12.2017	33.46	1644.8	1.66	-0.18	6.93	24.583	272.6
winch profile 2	11.12.2017	33.95	1667.1	1.45	-0.2	6.93	24.59	271.9

winch profile 2	11.12.2017	34.42	1704.1	1.04	-0.17	6.92	24.602	270.6
winch profile 2	11.12.2017	34.62	1741.9	0.6	-0.13	6.92	24.611	268.8
winch profile 2	11.12.2017	34.82	1771	0.38	0.04	6.91	24.62	266.5
winch profile 2	11.12.2017	35.02	1793.5	0.21	0.85	6.91	24.629	263.9
winch profile 2	11.12.2017	35.23	1852	<0.2	1.89	6.91	24.637	252.8
winch profile 2	11.12.2017	35.42	1877.1	<0.2	4.03	6.91	24.641	233.6
winch profile 3	11.12.2017	34.88	1769.4	0.53	0.06	6.93	24.608	282.6
winch profile 3	11.12.2017	35.38	1843.6	<0.2	3	6.91	24.632	280.6
winch profile 3	11.12.2017	35.60	1914.9	<0.2	6.04	6.92	24.644	274.4
winch profile 3	11.12.2017	35.81	2008.3	<0.2	6.71	6.94	24.654	150.8
winch profile 3	11.12.2017	35.98	2118.9	<0.2	3.01	6.93	24.662	70.9
winch profile 3	11.12.2017	36.28	2303.4	<0.2	1.58	6.92	24.672	20.3
winch profile 3	11.12.2017	36.47	2588.6	<0.2	0.64	6.91	24.681	-11.1
winch profile 3	11.12.2017	36.53	2697.4	<0.2	1.04	6.91	24.685	-30
winch profile 4	12.12.2017	35.42	1861.1	<0.2	2.99	6.93	24.619	191.1
winch profile 4	12.12.2017	36.44	2568.6	<0.2	0.74	6.92	24.692	-22.9
winch profile 4	12.12.2017	36.64	2891.5	<0.2	0.34	6.91	24.692	-42.8
winch profile 4	12.12.2017	36.83	3520	<0.2	0.06	6.91	24.705	-69.6
winch profile 4	12.12.2017	37.03	4288.2	<0.2	0.01	6.89	24.714	-87
winch profile 4	12.12.2017	37.20	5325.7	<0.2	-0.02	6.89	24.728	-108.8
diver profile 1	14.12.2017	35.39	2024.8	0.29	4.12	6.93	24.637	109.4
diver profile 1	14.12.2017	36.39	2487.7	<0.2	2.57	6.91	24.66	66
diver profile 1	14.12.2017	36.43	2522.6	<0.2	2.63	6.92	24.655	7.9
diver profile 1	14.12.2017	37.09	4552.2	<0.2	0.7	6.88	24.694	-10.4
diver profile 1	14.12.2017	37.53	9162.1	<0.2	0.29	6.86	24.736	-58.1
diver profile 1	14.12.2017	38.39	12773.4	<0.2	0	6.86	24.767	-104.2
diver profile 1	14.12.2017	38.55	17193.7	<0.2	-0.08	6.84	24.784	-117.5
diver profile 1	14.12.2017	39.98	24954.2	<0.2	-0.11	6.82	24.825	-133.1
diver profile 1	14.12.2017	40.57	32121.7	<0.2	-0.14	6.78	24.889	-139.1
diver profile 1	14.12.2017	41.68	36802.8	<0.2	-0.19	6.79	24.944	-148
diver profile 1	14.12.2017	42.19	38334.8	<0.2	-0.22	6.79	24.965	-148.6
diver profile 1	14.12.2017	44.20	41974.3	<0.2	-0.2	6.8	25.026	-147.6
diver profile 1	14.12.2017	44.05	42961.6	<0.2	-0.25	6.81	25.047	-145.5
diver profile 2	15.12.2017	40.11	27055.2	<0.2	-0.1	6.73	24.849	-83.7
diver profile 2	15.12.2017	48.98	48408.2	<0.2	-0.24	6.94	25.214	-133.3
diver profile 2	15.12.2017	43.51	41866.1	<0.2	-0.21	6.78	25.02	-135.9
diver profile 2	15.12.2017	39.31	19594	<0.2	-0.09	6.83	24.814	-139.4
diver profile 2	15.12.2017	45.62	44910.1	<0.2	-0.18	6.78	25.033	-136.3
diver profile 2	15.12.2017	47.80	46661.9	<0.2	-0.2	6.79	25.065	-136.4
diver profile 2	15.12.2017	50.53	48476.4	<0.2	-0.26	6.95	25.219	-131.4

diver profile 2	15.12.2017	49.09	48449.5	<0.2	-0.26	6.95	25.218	-131.5

Tables S2: Geochemical analyses of water samples from El Zapote Cenote.

Water geochemical analyses I

	measurment method:		ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	IC	IC	IC	TCA	TCA	TCA	PM	PM	PM	
Sample ID	Type	water depth corrected*	Ca	K	Mg	Na	Ba	Si	Sr	Cl	SO4	NO3	TOC	TC	IC	PO4	S(-II)	Nitrite	Ion Charge Balance***
		[m]	mmol/l	mmol/l	mmol/l	mmol/l	µmol/l	µmol/l	µmol/l	mmol/l	mmol/l	µmol/l	mmol/l	mmol/l	mmol/l	µmol/l	mmol/l	nmol/l	%
15m	winch	15.00	3.11	0.10	1.30	5.48	0.07	62.3	6.58	6.74	0.37	50.1	0.22	7.96	7.74	0.25			-2.95
28m	winch	28.00	3.10	0.11	1.35	5.70	0.07	63.0	6.40	6.77	0.37	43.6	0.17	7.96	7.79	0.42		bdl	-2.08
29m	winch	29.00	3.07	0.11	1.33	5.49	0.07	63.4	6.37	6.74	0.36	48.8	0.19	8.04	7.84	0.29		bdl	-3.25
30m	winch	30.00	3.09	0.10	1.33	5.45	0.07	62.0	6.34	6.68	0.36	60.2	0.22	8.03	7.81	0.20		bdl	-3.03
31m	winch	31.00	3.13	0.11	1.36	5.49	0.07	62.3	6.37	6.65	0.37	50.1	0.20	8.00	7.81	0.25		bdl	-2.29
32m	winch	32.00	3.18	0.12	1.42	6.00	0.07	63.0	6.39	7.07	0.38	45.0	0.16	7.97	7.81	0.55		bdl	-1.26
32,5m	winch	32.50	3.13	0.11	1.38	5.72	0.07	62.3	6.37	7.01	0.38	42.7	0.22	7.99	7.77	0.25		bdl	-2.37
33m	winch	33.00	3.11	0.12	1.42	6.07	0.07	64.1	6.48	7.72	0.41	38.6	0.15	8.01	7.87	0.29		bdl	-3.83
33,5m	winch	33.50	3.14	0.13	1.49	6.53	0.07	64.5	6.58	8.15	0.43	33.6	0.15	8.06	7.91	0.25		bdl	-3.13
34m	winch	34.00	3.19	0.13	1.50	6.76	0.07	64.1	6.56	8.06	0.43	37.7	0.22	8.11	7.89	0.33	bdl	bdl	-1.79
34,5m	winch	34.50	3.21	0.13	1.51	6.91	0.07	64.1	6.50	8.13	0.43	40.1	0.12	8.07	7.94	0.37	bdl	84.00	-1.44
35m	winch	35.00	3.21	0.14	1.56	7.30	0.07	65.2	6.61	8.72	0.46	38.2	0.15	8.02	7.87		bdl	14.00	-1.66
T_35,5	diver	36.00	3.36	0.22	1.99	11.28	0.08	72.3	7.29	12.8	0.60	4.8			8.29	0.98	0.01	bdl	-0.25
T_36	diver	36.39	3.48	0.31	2.47	14.83	0.08	80.1	8.05	17.6	0.85	1.5	0.17	8.80	8.63		0.34	bdl	-1.85
T_36.5	diver	36.43	3.43	0.30	2.43	14.76	0.08	79.8	8.05	17.7	0.86	5.6	0.23	8.73	8.50		0.32	bdl	-2.37
T_37	diver	37.09	3.84	0.61	4.14	30.22	0.11	107.7	11.76	34.2	1.72	1.5	0.35	9.76	9.41		0.92	bdl	-0.72
T_37,5	diver	37.53	4.68	1.32	7.96	63.04	0.14	151.4	18.55	73.2	2.81	5.9	0.62	12.49	11.88		0.77	bdl	-0.80
T_38	diver	38.39	5.48	1.80	11.09	92.17	0.17	181.6	25.68	105	3.74	10.3	0.61	13.57	12.96		2.80	bdl	-0.04
T_39	diver	38.55	6.30	2.48	15.25	130.00	0.20	204.1	33.45	148	5.41	11.0	1.06	15.17	14.11	7.45	4.13	bdl	0.15
T_40	diver	39.98	7.86	3.74	22.63	188.04	0.28	275.1	61.64	228	9.39	30.3	0.83	15.28	14.46	10.2	5.58	bdl	-2.25
T_41	diver	40.57	9.06	5.21	30.45	258.70	0.31	252.0	77.63	319	14.0	73.3	0.75	14.03	13.28	8.31	4.96		-2.92
T_42	diver	41.68	10.88	6.06	35.60	304.35	0.31	227.9	85.33	328	16.7	31.0	0.74	12.78	12.04	8.10	4.43		3.50
T_43	diver	42.19	11.25	6.47	37.90	319.57	0.31	200.3	91.32	353	19.3	29.1	0.45	10.16	9.71	7.03	4.42		2.49
T_44	diver	44.20	11.33	7.29	40.78	355.22	0.30	182.5	95.61	411	20.2	16.1	0.42	8.73	8.31	5.96	2.96		0.56
T_45	diver	44.05	12.03	7.27	41.15	355.22	0.27	154.9	95.61	408	22.8	27.4	0.43	7.72	7.30	4.88	2.88		0.68
T_34,7 Niskin	diver	36.8**	3.46	0.33	2.57	16.00	0.09	82.3	8.31	19.4	0.77	5.4	0.29	8.84	8.55	1.62	0.27	bdl	-2.11
P1/T	diver	35.8**	3.32	0.21	1.90	10.43	0.08	71.6	7.31	12.4	0.59	16.2	1.73	10.03	8.31	0.93	bdl	bdl	-1.95

P2/T	diver	35.2**	3.18	0.15	1.61	7.71	0.07	66.6	6.72	9.39	0.51	35.2	0.19	8.21	8.02	0.59	bdl	84.00	-2.80
P3/T	diver	35.3**	3.20	0.16	1.65	8.10	0.07	67.3	6.77	9.81	0.53	12.0	0.18	8.21	8.03	0.29	bdl	749.0	-2.54

* Water depths for winch samples were not corrected. Those taken by divers were corrected from the EXO-1 readings by aligning a sample to a steady depth.

** Water depths were estimated from the Na^+ concentration profile.

*** For the ion charge balance HCO_3^- was regarded as the only species of DIC and a species distribution of 50% HS^- and 50% H_2S for the total S(-II) was assumed.

bdl = below detection limit

Water geochemical analyses II

	measurment method:		ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	BID
Sample ID	Type	water depth corrected* [m]	Fe µmol/l	Mn µmol/l	P µmol/l	U nmol/l	Mo nmol/l	V nmol/l	CH4 µmol/l
15m	winch	15.00	0.16	0.01	0.47	12.4	6.21	59.7	0.04
28m	winch	28.00							0.09
29m	winch	29.00	0.10	0.01	0.45	12.5	5.84	59.7	
30m	winch	30.00							
31m	winch	31.00							
32m	winch	32.00	0.09	0.01	0.49	12.4	5.71	58.0	0.09
32,5m	winch	32.50							
33m	winch	33.00							
33,5m	winch	33.50							
34m	winch	34.00	0.08	0.00	0.46	12.5	5.59	55.1	0.07
34,5m	winch	34.50							
35m	winch	35.00	0.10	0.01	0.54	12.5	5.46	54.4	
T_35,5	diver	36.00	0.29	0.02	1.37	11.4	5.60	44.9	0.42
T_36	diver	36.39	0.34	0.02	2.12	10.6	4.71	40.2	
T_36.5	diver	36.43	0.47	0.02	1.92	10.7	5.01	39.3	12.37
T_37	diver	37.09	0.32	0.03	3.14	7.9	4.16	29.3	
T_37,5	diver	37.53	0.28	0.05	5.50	4.2	4.06	23.2	25.02
T_38	diver	38.39	0.31	0.05	6.81	3.0	3.93	18.4	
T_39	diver	38.55	0.33	0.06	8.52	2.1	3.41	17.4	24.88
T_40	diver	39.98	0.45	0.05	10.40	1.2	3.43	11.2	
T_41	diver	40.57	0.38	0.05	9.97	1.2	4.32	8.6	
T_42	diver	41.68	0.39	0.04	9.72	1.2	4.46	7.7	

T_43	diver	42.19							
T_44	diver	44.20							
T_45	diver	44.05	0.34	0.06	5.87	1.7	10.3	5.0	
T_34,7 Niskin	diver	36.8**							9.51
P1/T	diver	35.8**							
P2/T	diver	35.2**							
P3/T	diver	35.3**							

* Water depths for winch samples were not corrected. Those taken by divers were corrected from the EXO-1 readings by aligning a sample to a steady depth.

** Water depths were estimated from the Na concentration profile.

Table S3: Water Isotope geochemical analyses.

Sample ID	Type	water depth corrected* [m]	δ13C-CO2 ‰ (VPDB)	2σ ‰	δ13C-HCO3 at 23°C*** ‰ (VPDB)	2σ ‰	δ13C CH4 ‰ (VPDB)	2σ ‰
15m	winch	15.00	-18.18	0.17	-10.02	0.16	-48.8	0.3
28m	winch	28.00	-18.03	0.13	-9.87	0.13	-48.5	0.3
29m	winch	29.00						
30m	winch	30.00						
31m	winch	31.00						
32m	winch	32.00	-17.92	0.27	-9.76	0.29	-48.3	0.3
32,5m	winch	32.50						
33m	winch	33.00						
33,5m	winch	33.50						
34m	winch	34.00	-17.96	0.26	-9.80	0.20	-50.7	0.3
34,5m	winch	34.50						
35m	winch	35.00						
T_35,5	diver	36.00	-16.11	0.32	-7.95	0.37	-29.7	0.3
T_36	diver	36.39	-17.94	1.04	-9.78	0.51	-26.1	0.3
T_36.5	diver	36.43	-17.08	0.87	-8.92	0.39	-33.2	0.3
T_37	diver	37.09	-18.80	0.28	-10.64	0.28		
T_37,5	diver	37.53	-19.33	0.36	-11.17	0.30		
T_38	diver	38.39	-20.60	0.29	-12.44	0.35		
T_39	diver	38.55	-20.43	0.39	-12.27	0.55	-61.1	0.3
T_40	diver	39.98	-19.99	0.62	-11.83	0.55		
T_41	diver	40.57	-20.07	0.73	-11.91	0.65		
T_42	diver	41.68	-20.07	0.71	-11.91	0.68		

T_43	diver		42.19						
T_44	diver		44.20	-19.79	0.71	-11.63	0.69		
T_45	diver		44.05						
T_34,7 Niskin	diver	36.8**		-18.59	0.33	-10.43	0.26	-57.9	0.1
P1/T	diver	35.8**							
P2/T	diver	35.2**							
P3/T	diver	35.3**							

* Water depths for winch samples were not corrected. Those taken by divers were corrected from the EXO-1 readings by aligning a sample to a steady depth.

** Water depths were estimated from the Na concentration profile.

***δ13C-HCO3 calculated from δ13C-CO2 as equilibrium fractionation at 23°C after Mook (2001).

Table S4: Geochemistry of Hells Bells growing on the tree that fell into the cenote. Samples were taken from different water depths.

Sample No.	Sample ID	water depth [m]	Ca g/kg	Mg g/kg	Sr mg/kg	Ba mg/kg	P mg/kg	S mg/kg	Fe mg/kg	Mn mg/kg	δ13C [‰] (VPDB)	2σ	δ18O (VPDB) [‰] (VPDB)	2σ
1	Z17-18J-A	31.3												
2	Z17-18J-B	31.3	413	5.38	377	18.0	358	919	25.0	5.63	-13.47	0.01	3.81	0.01
3	Z17-1617-J-A	32.8	391	6.09	351	16.0	397	843	28.3	6.40	-13.69	0.01	3.31	0.02
4	Z17-1617-J-B	32.8												
5	Z17-14J-A	33.3	414	5.54	387	18.4	422	1010	22.1	5.85	-13.82	0.01	3.22	0.01
6	Z17-14J-B	33.3	401	5.44	339	15.7	349	814	17.1	5.74	-13.43	0.01	3.22	0.01
7	Z17-2J-A	33.8	406	5.92	332	12.9	585	1030	35.3	6.27	-12.99	0.01	3.00	0.01
8	Z17-2J-B	33.8	428	5.40	356	16.4	504	932	20.8	5.68	-13.52	0.01	3.18	0.02
9	Z17-13J-A	33.9	400	5.64	350	16.2	433	884	22.0	5.93	-13.68	0.01	3.30	0.01
10	Z17-13J-B	33.9												
11	Z17-9J-A	36.8	337	4.57	251	10.1	511	848	53.0	4.80	-12.87	0.02	2.74	0.01
12	Z17-9J-B	36.8	402	5.16	300	12.1	545	973	59.4	5.45	-12.85	0.00	2.79	0.01
13	Z17-3J-A	37.3	406	5.92	332	12.9	585	1030	35.3	6.27	-12.99	0.01	3.00	0.01
14	Z17-3J-B	37.3												

Table S5: Results and parameters as well as reported values used for the estimations on calcite precipitation rates in the redoxcline of El Zapote cenote.

estimations on calcite precipitation and growth rates in the redoxcline of El Zapote:				
$R_{ND\text{-}SO}$ (Eq 3)	7.3	mmol m^{-2} a^{-1}	2.2–6.2	kg a^{-1} in the area of the redoxcline
$R_{CO2\text{-}assim.}$ (Eq 4)	40	mmol m^{-2} a^{-1}	12–34	kg a^{-1} in the area of the redoxcline
$R_{dark\text{-}CO2\ fixation}$	37–420	mmol m^{-2} a^{-1}	31–420	kg a^{-1} in the area of the redoxcline
$\Sigma(R_{ND\text{-}SO} + R_{CO2\text{-}assim.})$	47.3	mmol m^{-2} a^{-1}	14.2–40.2	kg a^{-1} in the area of the redoxcline
growth rate	0.27–1.46	µm a^{-1}		
growth rate (on 1 % of the area)	27–146	µm a^{-1}		
reported net growth rates (Stinnesbeck et al. 2017b)	12–90	µm a^{-1}		
Parameters used for estimations of calcite precipitation rates at El Zapote:				
HS^- flux	6	10^{-4} µmol m^{-2} s^{-1}		
DIC(HCO_3^-) Fflux	2.5	10^{-3} µmol m^{-2} s^{-1}		
diameter circular of El Zapote	60–100	m		
redoxcline thickness	0.5	m		
calcite density	2.7	g cm^{-3}		
reported dark CO_2-fixation rates of marine and freshwater redoxclines used for the estimations of :$R_{dark\text{-}CO2\ fixation}$:				
Jørgensen et al. (1991)	0.2	µmol CO_2 l^{-1} d^{-1}	Black Sea	
Glaubitz et al. (2009)	0.5	µmol CO_2 l^{-1} d^{-1}	Baltic Sea	
Jost et al. (2008)	1	µmol CO_2 l^{-1} d^{-1}	Baltic Sea	
Noguerola et al. (2015)	2.7	µmol CO_2 l^{-1} d^{-1}	karstic lake pelagic redoxcline	