

HYDROGEOLOGY JOURNAL – ELECTRONIC SUPPLEMENTARY MATERIAL

Hydrogeology and geochemistry of the sulfur karst springs at Santa Cesarea Terme (Apulia, southern Italy)

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Table S1 - List of the values of temperature (T), pH, major and minor elements, and saturation indices (SI) for each sampling site from Fetida Cave (SCA1, SCAfin, SCB1, SCC1), Gattulla Cave (SCG1) and the Adriatic Sea (M1).

Date	T (°C)	pH	HS- (ppm)	Na (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)	Cl (ppm)	SO ₄ (ppm)	HCO ₃ (ppm)	NO ₃ (ppm)	Br (ppm)	F (ppm)	TDS (ppm)	Charge balance (%)	C-SI	G-SI	D-SI
SCA1																		
23/10/15	21.00	8.16	/	6670.00	345.05	566.11	1321.36	13167.00	2850.00	167.14	42.90	64.20	2.98	25196.74	0.09	1.11	-0.14	3.07
29/12/15	23.90	7.30	/	6857.50	329.15	751.65	824.59	12873.95	2135.30	189.52	44.70	58.60	2.20	17209.66	0.01	0.45	-0.13	1.40
10/12/16	24.70	7.35	1.98	9436.00	401.10	993.28	1005.62	17623.70	2331.91	338.52	43.20	67.80	3.95	22809.07	0.00	0.86	-0.03	2.17
08/06/17	22.50	7.34	0.02	6012.00	654.40	682.53	1218.01	11914.02	3353.98	163.89	/	188.83	3.64	18179.30	0.17	0.36	-0.08	1.43
29/12/17	18.10	7.59	0.02	9106.00	383.60	507.82	1177.75	16459.94	2820.31	174.93	0.00	71.62	1.29	21597.27	0.14	0.49	-0.22	1.83
07/05/18	25.40	7.10	0.37	5137.00	327.35	887.80	1107.11	10647.28	2945.10	174.51	49.40	80.26	1.41	16220.22	0.11	0.29	0.09	1.15
24/11/18	23.60	7.35	0.00	4822.00	307.50	743.33	979.95	15988.66	2679.72	210.99	46.89	69.64	1.07	21027.75	0.15	0.53	-0.04	1.65
SCAfin																		
23/10/15	21.90	7.86	/	7564.00	402.20	561.12	1215.60	13454.66	2533.00	183.05	1903.00	60.10	3.85	20316.58	0.04	0.84	-0.21	2.49
08/06/17	23.50	7.32	0.01	5349.41	450.50	618.43	1160.44	9803.71	4195.87	183.05	12.34	139.64	4.68	16568.66	0.20	0.36	0.08	1.47
29/12/17	19.30	7.37	0.01	8117.40	363.80	533.79	1106.09	13986.00	3882.25	183.05	0.00	62.44	1.27	20118.68	0.09	0.32	-0.05	1.43
07/05/18	22.20	7.38	0.47	6322.00	322.95	731.71	1254.58	12662.59	2917.13	171.46	0.00	72.46	1.32	18134.19	0.15	0.45	-0.02	1.62
24/11/18	25.50	7.25	0.00	4906.00	330.95	436.64	902.37	9240.82	2494.04	130.09	79.05	70.41	1.27	13685.63	0.15	0.01	-0.26	0.82
SCB1																		
29/12/15	25.30	7.20	/	5911.25	276.00	723.12	693.50	11126.03	1866.60	220.69	38.90	57.50	2.10	15004.44	0.00	0.44	-0.15	1.30
07/03/16	14.60	7.33	/	9683.75	448.40	459.74	1349.01	17691.69	3035.05	173.29	37.50	69.70	0.65	23265.03	0.00	0.19	-0.21	1.32
10/12/16	29.10	6.76	5.31	8568.00	381.60	1012.97	887.43	15872.00	2570.62	196.11	36.70	64.20	1.85	21023.47	0.01	0.10	0.06	0.53
08/06/17	25.50	6.96	0.82	8917.95	475.75	781.80	968.49	15475.09	3673.24	196.11	0.00	132.71	3.43	21708.53	0.06	0.16	0.10	0.83
29/12/17	21.20	7.13	0.01	7940.00	337.45	565.02	1036.46	14511.16	2586.58	196.11	0.00	67.54	1.36	19301.67	0.02	0.17	-0.17	1.06
07/05/18	26.70	6.89	2.14	7478.00	323.95	941.05	1055.97	14250.08	2908.25	173.29	0.00	82.19	1.04	19735.81	0.10	0.13	0.10	0.72
24/11/18	25.90	7.15	0.97	9454.14	337.60	826.78	884.44	16810.99	2608.22	206.54	0.00	72.52	1.38	21748.47	0.10	0.40	-0.02	1.23
SCC1																		
23/10/15	23.30	7.30	/	12464.00	175.65	430.86	639.41	20016.90	2429.65	240.54	32.60	65.25	2.25	24033.11	0.01	0.26	-0.41	1.16
29/12/15	25.20	7.20	/	6067.50	255.15	652.18	605.52	10766.00	2091.94	258.65	34.10	63.20	2.20	14728.94	0.02	0.40	-0.20	1.28
07/03/16	15.30	8.10	/	9107.50	433.30	461.56	1317.63	16721.27	3004.20	181.95	33.40	68.45	0.70	22222.46	0.01	0.93	-0.27	2.84
10/12/16	24.80	7.30	3.79	7119.00	328.70	859.21	773.75	12460.38	3261.40	219.23	37.20	66.80	1.95	18008.62	0.01	0.54	0.07	1.53
08/06/17	22.01	7.02	0.16	5110.20	229.00	280.81	286.95	8386.56	946.61	219.23	20.35	34.86	0.58	10412.22	0.93	-0.22	-0.84	0.14

29/12/17	21.30	7.12	0.03	10028.08	346.30	539.59	537.22	16291.32	2423.73	219.23	0.00	65.67	1.24	20424.29	0.17	0.13	-0.28	0.76
07/05/18	25.40	6.89	2.06	8706.08	244.95	744.75	831.98	15481.67	2326.54	233.08	0.00	63.77	1.60	19928.33	0.74	0.10	-0.16	0.71
24/11/18	25.60	7.22	0.15	9586.84	395.40	826.20	838.87	16910.66	2587.34	262.55	0.00	73.11	1.21	21901.01	1.09	0.51	-0.09	1.50
SCG1																		
29/12/15	19.70	7.20	/	10171.25	492.40	795.32	1245.12	18334.14	3630.00	185.06	54.15	54.32	2.85	24793.36	0.01	0.29	0.03	1.27
07/03/16	16.60	7.76	/	7516.80	364.50	432.10	1110.31	13900.90	2504.00	202.02	51.30	55.30	0.60	18621.03	0.01	0.62	-0.34	2.19
10/12/16	22.00	7.20	0.01	10144.00	430.95	758.55	1170.60	18595.61	2733.73	192.69	55.25	56.59	2.75	23996.72	0.01	0.30	-0.11	1.27
08/06/17	21.85	7.61	0.01	11190.73	594.10	795.74	1280.79	20527.04	2941.19	162.73	152.82	80.52	2.22	26537.15	0.04	0.65	-0.08	1.98
29/12/17	15.30	7.73	0.00	10573.75	451.50	459.25	1300.60	19042.35	2905.80	162.73	44.10	0.00	2.10	24368.43	0.02	0.50	-0.30	1.98
07/05/18	26.40	7.01	0.81	7454.47	255.50	900.17	1192.69	15018.85	2107.90	264.81	0.00	63.71	1.19	19804.81	0.12	0.35	-0.12	1.30
24/11/18	25.70	7.12	4.73	8640.46	333.40	865.54	1183.62	16457.13	2559.09	253.40	74.64	71.42	1.24	21803.05	0.10	0.42	-0.07	1.44
M1																		
29/12/15	15.70	8.20	0.00	10573.75	451.50	459.25	1300.60	19042.35	2905.80	186.40	44.10	0.00	2.10	24392.11	0.03	1.04	-0.30	3.05
08/06/17	19.80	8.18	0.00	12078.60	664.40	462.67	1337.07	21499.89	3100.47	194.76	45.10	75.16	2.04	27381.57	0.00	1.06	-0.29	3.05
07/05/18	21.10	8.19	0.00	11538.72	476.01	441.25	1376.70	20638.18	2999.06	183.05	0.00	62.30	1.02	26177.57	0.07	1.03	-0.32	3.02
24/11/18	19.50	8.21	0.00	11573.09	430.40	433.02	1181.90	19917.79	3221.74	162.79	0.00	67.42	0.57	25415.63	0.06	0.98	-0.29	2.89

Table S2 – List of the Trace and REE elements for each sampling site from Fetida Cave, Gattulla Cave and the Adriatic Sea.

Date	Trace Elements (ppm)												Rare Earth Elements (ppm)															
	Cu	Pb	Zn	Ni	Ba	Co	Cs	Ga	Rb	Sr	U	V	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Y	Ho	Er	Tm	Yb	Lu	
SCA1																												
23/10/15	0.0005				0.0034		0.0003	0.0002	0.0261	1.539	0.0003	0.0007	0.0001	0.0001	0.0001	0.0002		0.00	0.00	0.00	0.00	0.0001						
29/12/15	0.0005				0.0000		0.0001	0.0005	0.0185	1.628		0.0005	0.0001	0.0001	0.0000	0.0000	0.00	0.00	0.00	0.00	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	
10/12/16	0.0001				0.0174		0.0007	0.0007	0.0600		0.0002	0.0009	0.0004	0.0002	0.0001	0.0004	0.0001	0.0002	0.0001	0.00	0.0001	0.0003		0.0001	0.0003	0.0001	0.0001	
7/5/18	0.0014				0.0096		0.0005	0.0008	0.0324	0.8687	0.0003	0.00081	0.0001	0.0008	0.0001	0.00014	0.0001	0.0002	0.0001	0.0001	0.00013	0.0002	0.0001	0.0002	0.0002	0.0009	0.0002	
24/11/18	0.0048				0.0123		0.0003	0.0003	0.0170	0.3644	0.0002	0.00077	0.0001	0.0001	0.00014	0.0001	0.0001	0.0003	0.0003	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	
SCAfe																												
23/10/15	0.0004				0.0016		0.0001	0.0001	0.0161	0.9632		0.0004	0.0001		0.0001	0.0002		0.00	0.00	0.00	0.00	0.0004						
7/5/18	0.0017				0.0046		0.0005	0.0001	0.0696	0.0066	0.0008	0.00039	0.0001	0.0009	0.00014	0.0001	0.00	0.00	0.0002	0.0001	0.0005	0.0001	0.0001	0.0002	0.0001	0.0001	0.0008	
24/11/18	0.0018				0.0031		0.0002	0.0004	0.0356	0.5335	0.0002	0.00033	0.0001	0.0001	0.00011	0.0001	0.0002	0.0003	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	
SCB1																												
29/12/15	0.0010				0.0077		0.0002	0.0007	0.028	1.918		0.0006	0.0002	0.0002	0.00010	0.0001	0.0001	0.0001	0.0001	0.0000	0.0007	0.00	0.00	0.00	0.00	0.0003	0.0000	
7/3/16	0.0005				0.0017		0.0006	0.0006	0.0394	3.436		0.0004	0.0003	0.0002	0.00007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0001	0.0007	0.0003	0.0004	
10/12/16	0.0001				0.0028		0.0007	0.0009	0.0637	3.699		0.0001	0.0002	0.0002	0.0001	0.0008	0.0003	0.0003	0.0002	0.0001	0.0003	0.0001	0.0001	0.0002	0.0001	0.0002	0.0004	
7/5/18	0.0073				0.0034		0.0007	0.0002	0.097	0.725		0.00081	0.0001	0.0006	0.00014	0.0001	0.0001	0.0002	0.0001	0.0008	0.0001	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	
24/11/18	0.0016				0.0034		0.0003	0.0003	0.0137	0.3526		0.00067	0.0001	0.0002	0.00013	0.0001	0.0003	0.0002	0.0000	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	
SCC1																												
23/10/15	0.0017				0.0075		0.0001	0.0008	0.074	1.28		0.0011	0.0003	0.0004	0.0005	0.00018	0.0003	0.0001	0.0002	0.0000	0.0006	0.00	0.00	0.0001	0.0000	0.0009	0.0000	
29/12/15	0.0008				0.0050		0.0002	0.0011	0.099	1.892		0.0008	0.0001	0.0001	0.0001	0.0004	0.0000	0.0000	0.0000	0.0000	0.0005	0.00	0.00	0.00	0.00	0.00	0.0000	
7/3/16	0.0014				0.0018		0.0001	0.0001	0.074	5		0.0002	0.00014	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	
10/12/16	0.0003				0.0030		0.0005	0.0011	0.058	3.258		0.0001	0.0006	0.0003	0.0003	0.00015	0.0003	0.0004	0.0003	0.0000	0.0001	0.0002	0.0001	0.0001	0.0002	0.0009	0.0002	
7/5/18	0.0071				0.0066		0.0004	0.0002	0.087	0.4215		0.0002	0.00043	0.0001	0.0004	0.0008	0.0001	0.0001	0.0001	0.0003	0.0001	0.0001	0.0002	0.0001	0.0002	0.0001	0.0001	
24/11/18	0.0018				0.0061		0.0002	0.0006	0.0248	0.2528		0.0002	0.00042	0.0009	0.0007	0.00039	0.0005	0.0005	0.0009	0.0000	0.0004	0.0007	0.0001	0.0001	0.0006	0.0001	0.0001	
SCG1																												
29/12/15	0.0010				0.0031		0.0001	0.0001	0.076	1.304		0.0002	0.0000	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0003	0.00	0.00	0.00	0.00	0.00	0.0000	
7/3/16	0.0031				0.0034		0.0001	0.0003	0.060	3.371		0.0002	0.0002	0.0002	0.0006	0.0001	0.0001	0.0001	0.0003	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	
10/12/16	0.0009				0.0035		0.0005	0.0005	0.069	3.328		0.0003	0.0006	0.0006	0.00010	0.00034	0.0008	0.0004	0.0008	0.0000	0.0008	0.0007	0.0002	0.0009	0.0003	0.0002	0.00021	
7/5/18	0.0070				0.0044		0.0003	0.0002	0.082	0.7724		0.0002	0.00013	0.0003	0.0005	0.0001	0.0002	0.0002	0.0001	0.0004	0.0001	0.0001	0.0002	0.0001	0.0004	0.0001	0.0001	
24/11/18	0.0048				0.0052		0.0002	0.0001	0.099	0.1654		0.0004	0.0001	0.0002	0.00016	0.0004	0.0003	0.0003	0.0000	0.0007	0.0005	0.0001	0.0005	0.0001	0.00019	0.0006		

M1																												
29/12/15	0.00									0.01	0.82		0.00									0.000						
	05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50	88	0.00	04	0.00	0.00	0.00	01	0.00	0.00	0.00	0.00	03	0.00	0.00	0.00	0.00	0.00	0.00	
7/5/18				0.00	0.01	0.00	0.00	0.00	0.06	0.52	0.00	0.02			0.000	0.000			0.000		0.000			0.000	0.00000		0.0000	
	0.00	0.00	08	67	53	04	02	01	17	51	15	54	0.00	0.00	0.00	04	05	0.00	0.00	01	0.00	05	0.00	0.00	02	1	0.00	03
24/11/18	0.08		0.00	0.01		0.00						0.00	0.00	0.00	0.000	0.000		0.000	0.000		0.00							
	68	0.00	42	02	0.00	00	0.00	0.00	0.00	0.00	0.00	60	01	02	01	14	0.00	01	02	0.00	0.00	01	0.00	0.00	0.00	0.00	0.00	