

**Supplementary material for “Are large sulfur isotope variations biosignatures in an ancient, impact-induced hydrothermal Mars analog?”**

**Supplemental Table 1** Geochemical data ( $\delta^{34}\text{S}_{\text{CRS}}$ , CRS, TOC) from drill cores FBN 73 and SUBO 18. Reproducibilities (1SD) are 0.25‰ or better for  $\delta^{34}\text{S}_{\text{CRS}}$ , 0.07 wt% or better for CRS, and 0.1 wt% for TOC. \* = not measured, n.d. = not detected

Depth (m)	Notes	$\delta^{34}\text{S}_{\text{CRS}}$ (‰)	CRS (wt%)	TOC (wt%)
<b><i>FBN 73 (Nördlingen 1973 research drilling)</i></b>				
<b>Claystone member</b> Centimeter-scale laminated mudstone, dark gray, carbonaceous intercalations				
21.55 (403.5 m a.s.l.)		-33.3	0.35	1.0
27.55		0.2	2.08	1.2
28.55		6.4	2.37	1.7
29.55		4.0	2.33	1.1
32.95		-0.5	2.72	1.7
35.95		-17.7	0.30	0.9
37.95	Coal seam	14.4	5.65	15.6
38.95		11.7	0.70	3.4
43.575		0.2	1.18	1.0
49.1		2.8	0.29	1.8
<b>Marl member</b> Calcareous pale gray mudstone, massive to centimeter-scale bedding				
52.1		10.0	2.19	2.6
55.1		-1.3	0.28	1.3
58.1		-8.9	1.14	0.6
59.1		-3.8	0.40	0.2
63.1		0.8	2.29	1.2
65.1		5.8	0.47	1.8
78		-5.1	0.41	3.3
85.7		10.9	2.16	2.0
88.7		4.5	1.41	1.0
95.5		-1.6	1.29	1.3

98.5		1.7	1.99	2.0
105.5		9.1	1.73	2.3
106.5		7.7	1.32	2.0
107.5		9.2	0.81	2.0
109.5		7.5	0.32	2.8
111.5		7.0	1.25	2.2
113.5		13.0	1.69	2.0
118.5		3.5	1.19	2.5
121.5		8.1	1.67	2.9
125.5		22.4	0.23	4.9
127.5	Bituminous	15.2	0.31	14.6
134.5		19.6	0.77	6.4
140.5		24.2	0.54	7.0
<b>Laminite member</b>	<b>Millimeter-scale laminated mudstone, calcareous to bituminous</b>			
146.5		17.5	0.42	4.4
152.5		19.2	0.88	5.1
154.5	Bituminous	19.4	0.17	14.0
158.5		21.7	0.11	4.0
162.5		20.1	0.16	2.8
166.5		19.5	0.08	1.7
170.5		19.8	0.19	4.1
171.5		19.7	0.17	6.2
173.5	Bituminous	19.6	0.14	25.6
174.5	Bituminous	22.5	0.08	33.3
176.5	Bituminous	27.8	0.02	34.7
177.5	Bituminous	30.6	0.20	14.6
178.5		25.8	0.14	3.6
182.5		25.6	0.14	3.5
183.5		25.6	0.07	5.2

185.5	Bituminous	23.6	0.06	8.4
186.5	Bituminous	25.4	0.08	4.1
188.5	Bituminous	27.7	0.14	4.1
191.5	Bituminous	24.7	0.10	7.0
192.5	Bituminous	23.4	0.52	10.6
195.5	Bituminous	24.7	0.06	10.6
198.5		29.6	0.09	3.7
202.5		31.2	0.24	4.2
204.5	Bituminous	27.3	0.59	7.7
206.5		36.8	0.15	2.8
209.5		38.6	0.22	3.0
211.5		38.2	0.14	2.0
212.5		37.3	0.26	5.5
214.5		37.2	0.24	2.6
215.5		36.5	0.21	2.0
218.5		31.7	0.32	3.5
226.5		26.9	0.29	3.5
228.5	Bituminous	33.1	0.29	6.1
230.5	Bituminous	33.5	0.25	7.2
232.5		33.8	0.72	1.6
233.5		42.8	0.22	2.8
234.5		42.5	0.78	4.2
236.5		39.2	1.11	1.9
237.5		45.1	1.17	3.1
239.5	Bituminous	44.3	0.28	5.3
241.5	Bituminous	41.6	0.32	6.0
245.5	Bituminous	40.6	0.13	5.6
248.5	Bituminous	41.9	0.48	10.7
252.5	Bituminous	31.6	0.67	7.9

254.5		28.1	0.38	9.0
<b>Basal member</b>	Sandstone with interlaminated calcareous marlstone			
258.5	Marlstone	-19.0	1.38	4.2
260.5	Marlstone	-5.2	1.22	4.6
261.5	Marlstone	-5.5	1.43	0.2
<b><i>SUBO 18 (Enkingen drilling)</i></b>				
<b>Crater Suevite</b>	Polymict breccia with groundmass containing clastic and melt particles			
29.53 (385.47 m a.s.l.)		-10.0	0.42	< 0.1
30.75		-7.1	0.72	< 0.1
40.46		-19.8	1.04	< 0.1
45.57		-19.7	1.94	0.1
49.50		-20.7	0.85	0.2
50.87		-11.8	0.98	0.2
51.50		-19.3	0.07	0.8
52.48		-14.4	0.06	0.7
59.33		-22.4	1.32	< 0.1
60.79		-19.7	1.45	< 0.1
62.58		-17.3	1.54	0.1
66.42		-22.0	1.88	0.1
67.61		-25.3	2.37	< 0.1
68.59		-31.4	2.57	0.1
70.61		-23.3	2.06	< 0.1
71.61		-23.7	2.03	0.1
72.37		-23.1	1.76	< 0.1
76.44	Impact melt breccia	-17.5	0.11	0.4
78.23		-26.9	1.82	< 0.1
79.54		-24.7	1.54	0.1
80.73		-22.3	1.50	0.1
<b>Impact Melt Breccia</b>	Melt content > 50%, relatively poor in suevite groundmass			

83.29	-16.0	1.02	0.2
86.40	-15.7	0.08	0.3
87.95	-19.0	0.16	0.7
88.16	-18.3	0.04	0.2
90.93	-6.9	2.46	< 0.1
91.04	-7.7	1.52	< 0.1
92.11	-6.3	1.25	0.2
92.23	-16.9	2.09	< 0.1
93.43	9.1	1.15	0.2
94.28	*	n.d.	0.3
96.11	-11.3	1.10	0.3
97.28	3.5	0.37	0.1
99.35	5.3	0.51	0.3

**Supplemental Table 2** Geochemical data ( $\delta^{34}\text{S}_{\text{Bulk}}$ ,  $\delta^{34}\text{S}_{\text{Kerogen}}$ , TOC, TIC, TS) from NR-10, NR-20, NR-30, NR-40. Reproducibilities (1SD) are 0.25‰ or better for  $\delta^{34}\text{S}_{\text{Bulk}}$  and  $\delta^{34}\text{S}_{\text{Kerogen}}$ , and 0.1 wt% or better for TOC, TIC, and TS. \* = not measured

Adjusted Depth (m)	Unadjusted Depth (m)	Drill core	$\delta^{34}\text{S}_{\text{Bulk}}$ (‰)	TS (wt%)	TOC (wt%)	TIC (wt%)
<b><i>Bulk samples</i></b>						
51.5	81.5	NR-10	14.8	2.6	2.5	0.4
59.6	98.1	NR-20	10.2	1.5	2.9	0.4
92.7	92.7	NR-30	14.6	1.1	2.1	0.6
100	130	NR-10	11.0	2.0	7.2	1.2
107.2	145.7	NR-20	19.2	1.3	1.7	0.5
121.5	151.5	NR-10	21.3	2.1	12.3	1.5
123.8	153.8	NR-10	21.5	1.4	15	1.8
129.5	159.5	NR-10	21.1	1.7	11.9	1.5
140.5	170.5	NR-10	24.9	1.1	25.5	3.1

152	190.5	NR-20	24.7	1.4	7.7	1.2
159.3	46.8	NR-40	26.1	1.2	1.9	0.6
167.8	167.8	NR-30	29.2	2.2	7.8	1.2
189	227.5	NR-20	35.7	0.5	3.4	0.8
203.8	91.3	NR-40	25.1	2.2	4.6	0.9
206.5	236.5	NR-10	39.2	2.8	3.5	0.7
210.9	98.4	NR-40	27.9	3.1	7.7	1.1
214	214	NR-30	41.0	1.5	3.7	0.9
215.1	215.1	NR-30	40.4	3.6	10.3	1.3
218	218	NR-30	44.2	2.3	5.8	1.2
220	250	NR-10	40.1	3.6	14.4	1.8
221.4	221.4	NR-30	21.4	2.7	2.8	0.7
222.9	222.9	NR-30	18.0	3.8	8.4	1.0
240	278.5	NR-20	7.0	5.1	4.5	0.6
241.5	280	NR-20	7.4	3.3	4.0	0.9

***Kerogen extracts***

$\delta^{34}\text{S}_{\text{Kerogen}}$  (‰)

121.5	151.5	NR-10	21.5	*	*	*
220	250	NR-10	39.6	*	*	*
222.9	222.9	NR-30	18.1	*	*	*

**Supplemental Table 3** Geochemical data ( $\delta^{34}\text{S}_{\text{CAS}}$ , CAS, TIC, TOC, TS, CRS) for all field samples. Reproducibilities (1SD) are 0.25‰ or better for  $\delta^{34}\text{S}_{\text{CAS}}$ , 27 mg/kg (n = 3) for CAS, 0.07 wt% or better for CRS, and 0.1 wt% for TIC, TOC, and TS. \* = not measured, n.d. = not detected

Identifier	$\delta^{34}\text{S}_{\text{CAS}}$ (‰)	CAS (mg/kg)	TIC (wt%)	TOC (wt%)	TS (wt%)	CRS (wt%)
<b><i>Carbonate Mounds</i></b>						
Goldberg 1	29.2	3280	11.7	0.2	0.2	0.001
Goldberg 2	29.8	2825	11.8	0.2	0.1	0.003
Goldberg 3	26.4	4091	11.8	< 0.1	0.2	0.002

Goldberg 4	29.1	3460	11.3	0.5	0.1	0.001
Goldberg 5	32.5	3055	11.8	0.1	0.1	0.001
Goldberg 6	28.7	2775	11.6	0.3	0.1	n.d.
Wallerstein 1	44.5	1075	11.7	0.2	< 0.1	0.002
Wallerstein 2	36.3	1316	11.7	0.2	0.1	0.001
<b><i>Outer Suevite</i></b>						
Otting 1	*	*	≤ 0.1	≤ 0.1	< 0.1	0.001
Otting 2	*	*	≤ 0.1	≤ 0.1	< 0.1	n.d.
Riedweg 1	*	*	≤ 0.1	≤ 0.1	< 0.1	n.d.