



Supplement of

Carbon-containing pyrite spherules: mineral biosignatures in black smokers?

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Table S1 | Indexing of peaks identified on the diffractograms obtained by X-ray diffraction of the samples from different parts of the chimney's wall: internal (Int), middle (Mid) and external portions (Ext). Each identified peak is labelled with Bianchite (COD ID: 9014480), Marcasite (COD ID: 1011013), Pyrite (COD ID: 9015842), Sphalerite (COD ID: 1538617) or Chalcopyrite (COD ID: 9015636). The d-spacing of each peak was measured manually (no uncertainties calculated).

Internal portion (Int)		
d-spacing (Å)	Relative intensity (I %)	<i>h k l</i>
4.72	2	[1 0 1] 4.7138 Chalcopyrite
3.13	6	[1 1 1] 3.1258 Pyrite
3.05	100	[1 1 2] 3.0368 Chalcopyrite
2.91	1	[1 0 3] 2.9025 Chalcopyrite
2.71	3	[2 0 0] 2.7070 Pyrite
2.65	3	[2 0 0] 2.6428 Chalcopyrite
2.61	1	[0 0 4] 2.6048 Chalcopyrite
2.43	3	[2 1 0] 2.4212 Pyrite
2.31	2	[2 1 1] 2.3052 Chalcopyrite
2.21	2	[2 1 1] 2.2103 Pyrite
1.92	5	[2 2 0] 1.9141 Pyrite
1.87	10	[2 2 0] 1.8688 Chalcopyrite
1.86	63	[2 0 4] 1.8552 Chalcopyrite
1.74	2	[3 0 1] 1.7372 Chalcopyrite
1.63	4	[3 1 1] 1.6324 Pyrite
1.59	24	[3 1 2] 1.5916 Chalcopyrite

1.58	6	[1 1 6] 1.5748 Chalcopyrite
1.56	1	[2 2 2] 1.5629 Pyrite
1.52	2	[2 2 4] 1.5184 Chalcopyrite
1.50	1	[3 0 2] 1.5016 Pyrite
1.45	2	[3 2 1] 1.4470 Pyrite
1.32	3	[4 0 0] 1.3214 Chalcopyrite
1.30	2	[0 0 8] 1.3024 Chalcopyrite

Middle portion (Mid)		
d-spacing (Å)	Relative intensity (I%)	<i>h k l</i>
4.70	2	[1 0 1] 4.7138 Chalcopyrite
3.13	13	[1 1 1] 3.1258 Pyrite
3.12	24	[1 1 1] 3.1200 Sphalerite
3.03	100	[1 1 2] 3.0368 Chalcopyrite
2.90	2	[1 0 3] 2.9025 Chalcopyrite
2.70	16	[2 0 0] 2.7070 Pyrite
2.69	5	[2 0 0] 2.7020 Sphalerite
2.64	4	[2 0 0] 2.6428 Chalcopyrite
2.60	2	[0 0 4] 2.6048 Chalcopyrite
2.42	13	[2 1 0] 2.4212 Pyrite
2.31	3	[2 1 1] 2.3052 Chalcopyrite

2.21	9	[2 1 1] 2.2103 Pyrite
1.95	1	[2 1 3] 1.9541 Chalcopyrite
1.91	8	[2 2 0] 1.9141 Pyrite
1.91	13	[2 2 0] 1.9106 Sphalerite
1.87	15	[2 2 0] 1.8688 Chalcopyrite
1.85	27	[2 0 4] 1.8552 Chalcopyrite
1.76	3	[3 0 1] 1.7372 Chalcopyrite
1.63	14	[3 1 1] 1.6324 Pyrite
1.63	10	[3 1 1] 1.6294 Sphalerite
1.59	24	[3 1 2] 1.5916 Chalcopyrite
1.58	9	[1 1 6] 1.5748 Chalcopyrite
1.56	3	[2 2 2] 1.5629 Pyrite
1.56	1	[2 2 2] 1.5600 Sphalerite
1.52	2	[2 2 4] 1.5184 Chalcopyrite
1.50	3	[3 0 2] 1.5016 Pyrite
1.45	4	[3 2 1] 1.4470 Pyrite
1.35	1	[4 0 0] 1.3510 Sphalerite
1.32	3	[4 0 0] 1.3214 Chalcopyrite
1.30	2	[0 0 8] 1.3024 Chalcopyrite

External portion (Ext)		
d-spacing (Å)	Relative intensity (I %)	<i>h k l</i>
5.98	3	[0 0 4] 6.0041 Bianchite
5.83	8	[1 1 0] 5.8436 Bianchite
5.55	2	[1 1 1] 5.5678 Bianchite
5.42	10	[1 1 -2] 5.4441 Bianchite
5.07	6	[1 1 2] 5.0834 Bianchite
4.92	7	[2 0 0] 4.9363 Bianchite
4.82	5	[2 0 -2] 4.8216 Bianchite
4.53	6	[1 1 3] 4.5358 Bianchite
4.37	29	[1 1 -4] 4.3825 Bianchite
4.34	3.6	[2 0 2] 4.3465 Bianchite
4.12	5	[2 0 -4] 4.1217 Bianchite
4.01	15	[1 1 4] 4.0167 Bianchite
3.87	2	[1 1 -5] 3.8799 Bianchite
3.61	8	[0 2 0] 3.6250 Bianchite
3.58	3	[0 2 1] 3.5844 Bianchite
3.56	6	[2 0 4] 3.5618 Bianchite
3.43	12	[1 1 0] 3.4313 Marcasite
3.13	2	[1 1 1] 3.1258 Pyrite

3.12	100	[1 1 1] 3.1200 Sphalerite
3.03	18	[1 1 2] 3.0368 Chalcopyrite
3.00	6	[3 1 -2] 3.0034 Bianchite
2.99	6	[3 1 0] 2.9966 Bianchite
2.92	4	[2 2 0] 2.9218 Bianchite
2.91	7	[2 0 6] 2.9071 Bianchite
2.90	5	[2 2 -2] 2.8975 Bianchite
2.88	2	[2 2 1] 2.8706 Bianchite
2.79	2	[2 2 2] 2.7839 Bianchite
2.71	33	[0 2 0] 2.7070 Marcasite
2.71	35	[2 0 0] 2.7070 Pyrite
2.70	24	[2 0 0] 2.7020 Sphalerite
2.69	27	[1 0 1] 2.6890 Marcasite
2.58	3	[1 1 8] 2.5806 Bianchite
2.52	3	[1 1 -9] 2.5113 Bianchite
2.49	2	[4 0 -2] 2.4909 Bianchite
2.45	3	[2 2 -6] 2.4642 Bianchite
2.42	20	[2 1 0] 2.4212 Pyrite
2.41	16	[1 1 1] 2.4083 Marcasite

2.31	14	[1 2 0] 2.3107 Marcasite
2.28	3	[3 1 -8] 2.2788 Bianchite
2.21	13	[2 1 1] 2.2103 Pyrite
2.05	2	[2 1 0] 2.0524 Marcasite
2.01	2	[4 2 -4] 2.0074 Bianchite
1.99	4	[3 1 8] 1.9918 Bianchite
1.92	55	[2 2 0] 1.9141 Pyrite
1.91	38	[2 2 0] 1.9106 Sphalerite
1.91	24	[1 2 1] 1.9077 Marcasite
1.87	5	[2 2 0] 1.8688 Chalcopyrite
1.86	4	[4 2 4] 1.8640 Bianchite
1.85	4	[2 0 4] 1.8552 Chalcopyrite
1.76	14	[2 1 1] 1.7545 Marcasite
1.71	2	[2 2 0] 1.7156 Marcasite
1.69	4	[0 0 2] 1.6905 Marcasite
1.67	5	[1 3 0] 1.6716 Marcasite
1.63	35	[3 1 1] 1.6324 Pyrite
1.63	23	[3 1 1] 1.6294 Sphalerite
1.59	8	[0 3 1] 1.5921 Marcasite

1.59	7	[3 1 2] 1.5916 Chalcopyrite
1.58	2	[1 1 6] 1.5748 Chalcopyrite
1.56	3	[2 2 2] 1.5629 Pyrite
1.56	4	[2 2 2] 1.5600 Sphalerite
1.53	2	[2 2 1] 1.5299 Marcasite
1.52	2	[1 1 2] 1.5164 Marcasite
1.50	7	[3 0 2] 1.5016 Pyrite
1.50	4	[1 3 1] 1.4985 Marcasite
1.45	5	[3 2 1] 1.4470 Pyrite
1.43	2	[0 2 2] 1.4339 Marcasite
1.43	3	[3 1 0] 1.4264 Marcasite
1.37	3	[1 2 2] 1.3644 Marcasite
1.35	5	[4 0 0] 1.3510 Sphalerite

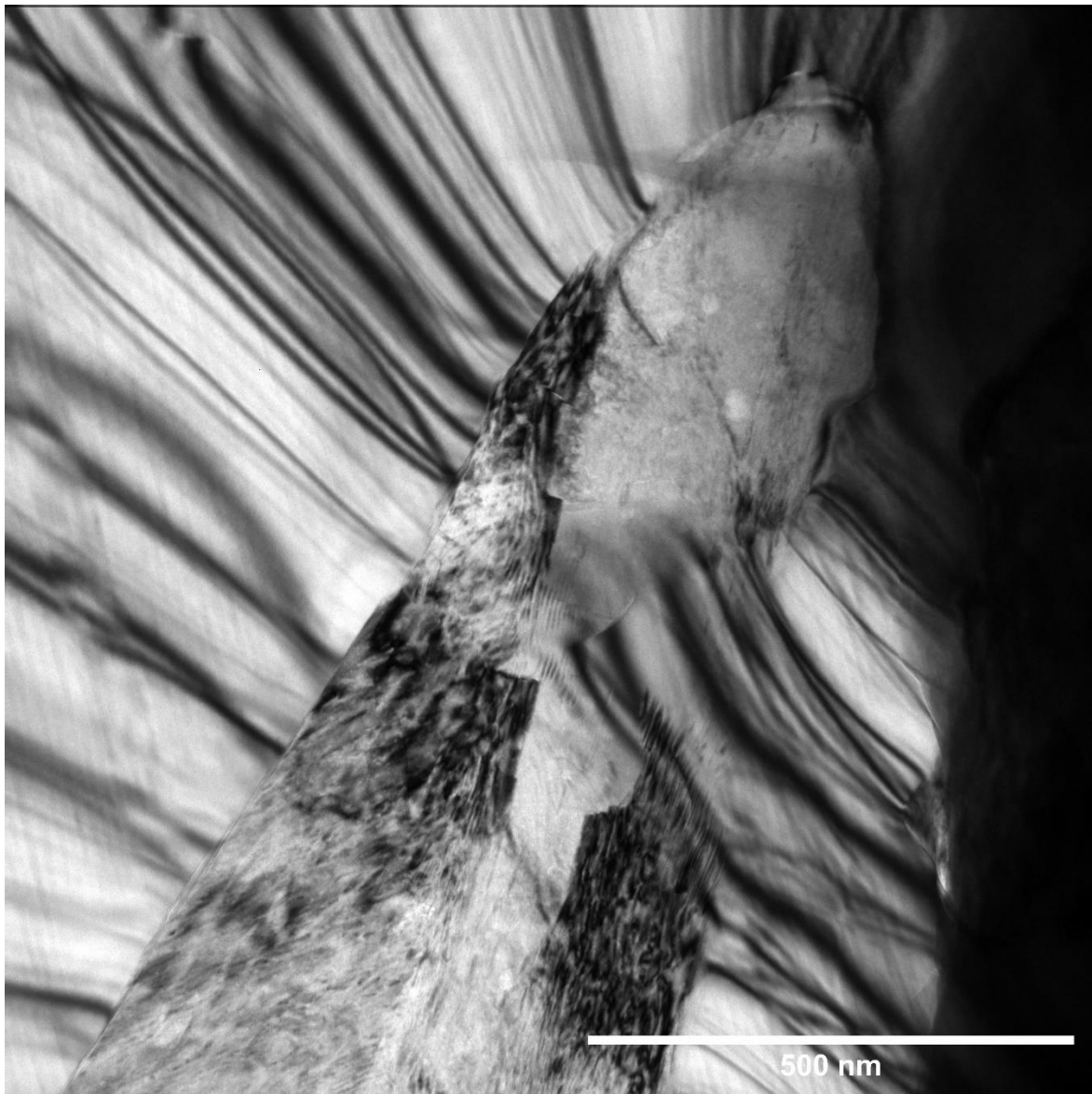


Figure S1 | Micrometric ZnS inclusion into pyrite. The inclusion appears as a single crystal of sphalerite.

Table S2 | Elemental composition (CHNS) given in mass fraction of TAG hydrothermal vent samples corresponding to different parts of the lead: interior (Int), middle (Mid), exterior (Ext). Uncertainties (\pm) on the reported values are given considering reproducibility to the hundredth on a measurement triplicate. Also shown are the [C]_{STXM} values providing a qualitative estimation of the carbon content of the pyrites (note that it is not a true concentration).

	Mass fraction of C %	Mass fraction of H %	Mass fraction of N %	Mass fraction of S%	Mass fraction of others % (calculated)	[C] _{STXM}
Int	0.08 (2)	0.05 (4)	0	32.40 (5)	67.47	1.6
Mid	0.14 (2)	0.05 (2)	0	37.50 (9)	62.31	2.6
Ext	0.21 (9)	0.08 (2)	0	40.00 (9)	59.71	7.6 (ExtA)
						8.8 (ExtB)