

**Electronic Supplementary Information(ESI):**

**Isotope geochemistry, hydrochemistry, mineralogy of the  
river affected by acid mine drainage in mining area, South  
China**

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Table S1: Aqueous parameters (pH; ORP and DO) in the Hengshi River in Jan/Aug/Nov 2016.

Sampling	pH			ORP		DO	
	2016.1	2016.8	2016.11	2016.1	2016.11	2011.8	2011.11
S0	2.67	2.63	2.98	442	332	5.7	7.2
S1	2.7	2.77	3.07	450	330	4.3	4.2
S3	2.98	9.38	6.95	420	101	6.6	7.3
C1	6.72	7.25	7.04	274	91	6.8	1.7
S4	3.22	8.94	10.3	418	-86	6.5	7.3
S5	3	8.9	9.33	432	-34	5.8	7.6
C2	/	5.75	8.76	/	5	6.4	7.9
S6	3.79	5.86	9.03	392	-12	6.2	8.3
S7	3.27	5.88	8.12	414	32	5.2	8
TP	7.01	7.25	7.49	253	69	6.5	6.4
S8	4.7	6.99	7.82	293	53	5.8	7.2
S9	6.4	7.12	7.76	229	55	6.4	7.4
S10	6.77	6.82	7.61	203	63	6.1	7.7
C3	7.18	7.14	7.59	204	67	4.9	4.5
S11	6.91	6.96	7.55	192	67	3.5	4.4

Table S2: Concentrations of  $\text{SO}_4^{2-}$  in the Hengshi River in Jan/Aug/Nov 2016.

Sampling	$\text{SO}_4^{2-}$ (mg/L)		
	2016.1	2016.8	2016.11
S0	4837.84	4008.04±94.73	4392.20 ±66.74
S1	4008.76	5717.88 ±87.05	6745.64 ±262.52
S3	3011.17	1823.26 ±33.38	2809.61 ±106.79
C1	5.22	4.56 ±0.16	4.66 ±0.93
S4	2114.55	107.12 ±28.15	1776.07 ±26.70
S5	1934.41	/	1760.34 ±13.35
C2	324.88	230.34±1.84	314.47 ±15.57
S6	511.50	280.37 ±11.84	389.19 ±0.89
S7	770.47	472.27 ±6.31	620.13 ±16.91
TP	14.80	14.43 ±0.54	26.84 ±0.36
S8	255.55	162.33 ±4.30	360.25 ±0.89
S9	129.69	96.27 ±1.95	147.56 ±5.34
S10	103.74	104.50 ±1.22	78.66 ±0.67
C3	23.43	24.29 ±7.02	30.05 ±0.62
S11	54.23	56.82 ±1.37	9.38 ±0.40

Table S3: Concentrations of total Fe and Fe<sup>2+</sup> in the Hengshi River in Jan/Aug/Nov 2016.

Sampling	Total Fe(mg/L)			Fe <sup>2+</sup> (mg/L)	
	2016.1	2016.8	2016.11	2016.8	2016.11
S0	646.78	347.78	495.07±10.8	49.56±3.70	7.01±0.43
S1	347.31	400.48±23.93	646.13±5.57	356.92±4.05	488.11±14.23
S3	176.72	0.21±0.01	0.22±0.06	0.35±0.07	0.07±0.04
C1	0.00	0.05±0.03	0.11±0.05	0.04±0.03	0.15±0.07
S4	57.06	0.14±0.02	0.15±0.01	0.07±0.01	0.04±0.01
S5	74.44	/	0.14±0.07	/	0.04±0.01
C2	0.42	0.25±0.01	0.15±0.02	7.05±0.54	0.21±0.06
S6	0.90	0.34±0.01	0.31±0.19	4.63±0.67	0.09±0.04
S7	12.08	0.16±0.01	0.16±0.02	2.25±0.03	0.14±0.01
TP	0.00	0.08±0.02	0.10±0.02	0	0.12±0.01
S8	0.24	0.16±0.04	0.10±0.02	0.03±0.02	0.045±0.01
S9	0.00	0.05±0.05	0.16±0.11	0.02±0.01	0.08±0.07
S10	0.00	0.09±0.04	0.13±0.08	0.032±0.17	0.09±0.03
C3	0.00	0.11±0.03	0.12±0.04	0.04±0.01	0.04±0.01
S11	0.00	0.09±0.01	0.22±0.12	0.02±0.01	0.09±0.03

Table S4: Concentrations of Cu<sup>2+</sup> and Zn<sup>2+</sup> in the Hengshi River in Jan/Aug/Nov 2016.

Sampling	Cu <sup>2+</sup> (mg/L)			Zn <sup>2+</sup> (mg/L)		
	2016.1	2016.8	2016.11	2016.1	2016.8	2016.11
S0	45.20	17.18 ±0.41	35.06 ±3.64	128.87	122.91 ±4.15	96.48±2.00
S1	11.89	4.42 ±0.02	9.22 ±0.12	94.65	128.56 ±3.17	116.82 ±1.52
S3	5.59	0.02 ±0.001	0.05 ±0.02	63.67	0.36 ±0.01	0.13 ±0.05
C1	0.03	0.01±0.001	0.01 ±0.004	0.00	0.01 ±0.002	0.02 ±0.01
S4	3.81	0.03 ±0.001	0.02 ±0.002	41.54	0.27 ±0.004	0.14 ±0.03
S5	4.26	/	0.02 ±0.001	46.92	/	0.13 ±0.11
C2	0.88	0.56 ±0.001	0.02 ±0.004	1.46	0.77±0.01	0.64 ±0.29
S6	0.93	0.38 ±0.001	0.03 ±0.001	2.52	0.75 ±0.003	0.24 ±0.01
S7	1.61	0.34 ±0.001	0.02 ±0.001	11.52	1.20 ±0.003	0.29 ±0.001
TP	0.04	0.01 ±0.001	0.01 ±0.002	0.00	0.01 ±0.001	0.03 ±0.03
S8	0.76	0.02 ±0.001	0.01 ±0.001	4.50	0.23 ±0.006	0.13 ±0.001
S9	0.04	0.01 ±0.001	0.01 ±0.001	1.45	0.09 ±0.003	0.10 ±0.06
S10	0.04	0.02 ±0.001	0.01 ±0.004	1.19	0.28 ±0.003	0.07 ±0.001
C3	0.04	0.01 ±0.001	0.01 ±0.004	0.00	0.01 ±0.004	0.05 ±0.01
S11	0.04	0.01 ±0.001	0.01 ±0.002	0.58	0.10 ±0.003	0.16 ±0.11

Table S5: Concentrations of Ca<sup>2+</sup> and Mg<sup>2+</sup> in the Hengshi River in Jan/Aug/Nov 2016.

Sampling	Ca <sup>2+</sup> (mg/L)			Mg <sup>2+</sup> (mg/L)		
	2016.1	2016.8	2016.11	2016.1	2016.8	2016.11
<b>S0</b>	24.30	68.24 ±1.87	68.20 ±10.80	182.00	100.68 ±0.60	118.59 ±13.17
<b>S1</b>	107.40	269.34 ±2.99	289.84 ±0.78	177.30	207.49 ±4.77	230.54 ±3.43
<b>S3</b>	261.23	586.08 ±6.34	701.71 ±25.60	129.92	44.13 ±1.10	66.02 ±3.73
<b>C1</b>	11.78	10.17 ±0.26	14.02 ±0.07	1.76	1.55 ±0.02	2.13 ±0.02
<b>S4</b>	186.91	345.74 ±13.39	655.28 ±20.8	93.04	26.65 ±0.92	27.73 ±0.81
<b>S5</b>	212.22	/	609.95 ±21.30	104.15	/	42.91 ±2.16
<b>C2</b>	65.70	39.95 ±0.84	69.22 ±0.81	19.87	8.45 ±0.13	9.56 ±0.06
<b>S6</b>	65.20	71.56 ±1.00	77.28 ±0.51	20.22	10.49 ±0.06	9.94 ±0.23
<b>S7</b>	85.86	136.68 ±4.00	145.67 ±1.46	19.08	15.62 ±0.22	16.18 ±0.10
<b>TP</b>	14.00	17.90 ±0.32	24.92 ±0.27	1.29	1.53 ±0.07	1.94 ±0.01
<b>S8</b>	43.57	61.00 ±0.72	102.71 ±11.65	14.83	6.55 ±0.09	11.18 ±0.41
<b>S9</b>	36.34	42.48 ±0.27	57.48 ±1.68	7.90	4.75 ±0.20	4.59 ±0.07
<b>S10</b>	43.44	46.65 ±3.86	49.31 ±0.34	7.12	5.03 ±0.18	3.99 ±0.003
<b>C3</b>	28.92	21.96 ±0.25	29.87 ±1.02	2.43	2.10 ±0.05	2.49 ±0.06
<b>S11</b>	30.27	28.98 ±0.81	34.19 ±0.28	4.14	3.09 ±0.04	3.11 ±0.03

Table S6: Concentration distributions of organic matter (OM), Water soluble sulfate (WS) and exchangeable sulfate (ExS) in sediment samples along the Hengshi River.

Sampling	Organic Matter (%)		Water soluble sulfate (mg/g)		Exchangeable sulfate(mg/g)	
	2016.8	2016.11	2016.8	2016.11	2016.8	2016.11
<b>S0</b>	1.82 ±0.16	0.59 ±0.03	3.61 ±0.19	2.18 ±0.03	2.56 ±0.34	2.62 ±0.21
<b>S1</b>	1.98 ±0.60	0.86 ±0.21	1.52 ±0.2	2.03 ±0.01	2.99 ±0.02	3.77 ±0.04
<b>S3</b>	1.96 ±0.26	0.72 ±0.04	5.08 ±0.22	6.13 ±0.24	10.36 ±0.41	10.44 ±0.07
<b>C1</b>	3.26 ±67	2.24 ±0.06	0.04 ±0.01	0.09 ±0.01	0.02 ±0.00	0.06 ±0.00
<b>S4</b>	2.53 ±0.11	0.87 ±0.04	3.00 ±0.12	11.49 ±0.38	6.63 ±0.21	15.96 ±0.31
<b>S5</b>	/	0.96 ±0.11	/	3.83 ±0.21	/	6.96 ±0.29
<b>C2</b>	/	2.02 ±0.03	/	1.19 ±0.01	/	5.41 ±0.11
<b>S6</b>	3.10 ±0.15	2.17 ±0.19	1.89 ±0.09	3.72 ±0.02	10.82 ±0.51	4.15 ±0.01
<b>S7</b>	2.53 ±0.24	2.17 ±0.03	2.85 ±0.07	2.54 ±0.05	12.93 ±0.81	3.69 ±0.01
<b>TP</b>	3.00 ±0.10	5.14 ±0.63	0.11 ±0.01	0.28 ±0.01	0.07 ±0.00	0.23 ±0.00
<b>S8</b>	6.29 ±0.04	1.97 ±0.11	1.28 ±0.01	1.87 ±0.05	3.12 ±0.02	2.80 ±0.02
<b>S9</b>	3.77 ±0.39	2.57 ±0.13	1.39 ±0.03	0.95 ±0.01	1.27 ±0.01	1.17 ±0.01
<b>S10</b>	2.41 ±0.22	2.80 ±0.10	1.01 ±0.01	0.52 ±0.01	1.27 ±0.10	1.16 ±0.01
<b>C3</b>	2.97 ±0.60	3.09 ±0.23	0.14 ±0.01	0.09 ±0.02	0.18 ±0.01	0.18 ±0.01
<b>S11</b>	3.24 ±0.66	1.95 ±0.19	0.60 ±0.01	0.26 ±0.01	0.56 ±0.00	0.62 ±0.02

Table S7: Variations of  $\delta^{34}\text{S}$  and  $\delta^{18}\text{O}$  of dissolved  $\text{SO}_4^{2-}$  along the Hengshi River

Sampling	$\delta^{34}\text{S}(\text{‰}; \text{VCDT})$			$\delta^{18}\text{O}(\text{‰}; \text{SMOW})$
	2016.1	2016.8	2016.11	2016.1
<b>S0</b>	-1.53	-1.75 ±0.05	-1.67 ±0.01	-3.18
<b>S1</b>	-1.23	-1.17 ±0.01	-1.10 ±0.05	-2.66
<b>S3</b>	-1.19	-1.17 ±0.01	-1.39 ±0.04	-2.48
<b>C1</b>	/	2.92 ±0.01	4.02 ±0.03	/
<b>S4</b>	-1.19	-1.10 ±0.01	-1.26 ±0.01	-2.61
<b>S5</b>	-1.16	/	-1.30 ±0.04	-2.54
<b>C2</b>	-0.44	-0.71 ±0.02	-0.56 ±0.02	-3.97
<b>S6</b>	-0.45	-0.87 ±0.08	-0.50 ±0.01	-2.85
<b>S7</b>	-0.88	-1.03 ±0.01	-0.91 ±0.1	-2.68
<b>TP</b>	/	3.54 ±0.04	3.61 ±0.01	/
<b>S8</b>	-0.75	-0.82 ±0.07	-0.97 ±0.02	-2.59
<b>S9</b>	0.02	0.15 ±0.02	-0.34 ±0.03	-0.33
<b>S10</b>	0.21	0.16 ±0.01	0.65 ±0.001	0.16
<b>C3</b>	-0.32	4.07 ±0.09	4.86 ±0.01	-2.76
<b>S11</b>	1.99	2.61 ±0.09	2.92 ±0.01	4.31
<b>The tailing impoundment</b>	-0.23	/	/	-3.41

Table S8: Aqueous parameters (pH; ORP and DO) in the Hengshi River in the previous paper. (Chemosphere 2015, 119, 734-743)

	pH		ORP		DO	
	2012.7	2012.11	2012.7	2012.11	2012.7	2012.11
<b>S1</b>	2.8	2.7	583	481	2.73	9.6
<b>S2</b>	2.8	2.8	593	564	4.53	8.75
<b>S3</b>	3	2.9	467	568	4.62	7.6
<b>C1</b>	5.8	5.8	/	/	5.47	7.76
<b>S4</b>	3.1	3	472	583	4.9	7.8
<b>S5</b>	3.1	3	509	581	5.96	8.38
<b>C2</b>	4.8	4.5	/	/	6.19	7.73
<b>S6</b>	3.9	3	547	547	5.95	8.9
<b>S7</b>	4.3	4.1	453	535	5.07	7
<b>S8</b>	4.8	5.2	433	384	5.67	6.08
<b>S9</b>	5.4	5.4	280	230	5.94	7.44
<b>C3</b>	6	5.4	/	/	5.64	5.25
<b>S10</b>	5.4	5.5	235	229	4.73	9.01
<b>S11</b>	5.7	5.8	205	225	4.02	5.85