

Supplementary Materials for

**Jarosite formation in the Permian-Triassic sequences at Xiakou (South China):
Implication for jarosite precipitation from H₂S upwelling on Mars**

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Tables S1 to S2

Fig. S1

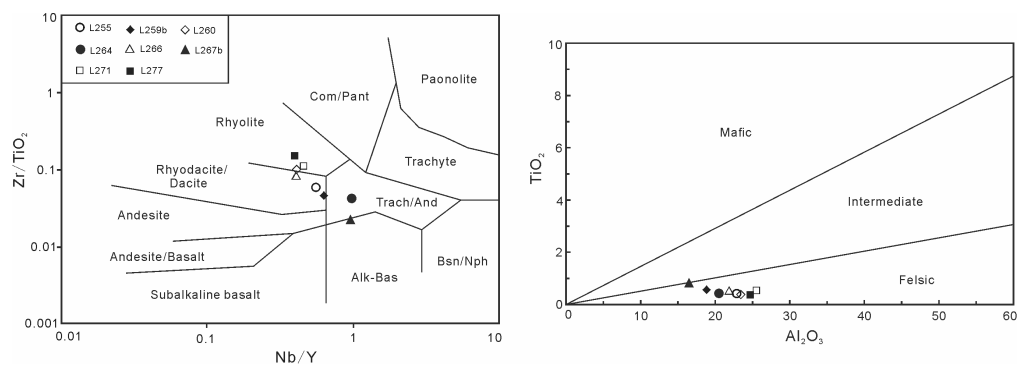


Fig. S1 Plots of (A) TiO₂ versus Al₂O₃ and (B) Zr/TiO₂ versus Nb/Y showing felsic-intermediate source rocks for the Xiakou tuffs. (Chemical compositions in Tables S3, S4)

Table S1 Major element compositions of the Xiakou sediments (wt%)

Sample	Lithology	SiO ₂	TiO ₂	Al ₂ O ₃	TFe ₂ O ₃	MnO	MgO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	LOI	Sum
L278	Mudstone	36.64	0.514	9.85	2.96	0.100	8.33	14.99	0.61	2.69	0.089	21.82	98.59
L277	Tuff	52.30	0.355	24.64	2.56	0.003	3.43	1.27	0.07	6.07	0.033	7.31	98.02
L276	Mudstone	41.69	0.561	10.48	3.52	0.071	5.58	14.55	0.72	2.76	0.107	18.59	98.62
L272	Marl	23.39	0.221	5.11	3.28	0.111	6.36	28.23	0.40	1.30	0.075	28.60	97.08
L271	Tuff	53.34	0.498	25.49	1.33	0.004	3.58	1.31	0.08	6.18	0.037	7.11	98.96
L270	Marl	17.74	0.219	3.90	3.97	0.084	4.14	33.65	0.45	0.89	0.076	31.04	96.16
L268	Mudstone	49.76	0.733	14.07	6.49	0.053	4.44	5.72	0.88	3.67	0.102	11.56	97.48
L267b	Tuff	57.82	0.854	16.32	5.92	0.017	2.43	1.69	1.04	4.49	0.125	6.59	97.29
L267a	Mudstone	38.83	0.510	10.90	5.02	0.102	7.36	12.33	0.66	2.73	0.086	18.99	97.52
L266a	Mudstone	25.35	0.166	3.38	2.05	0.208	12.05	23.09	0.27	0.95	0.044	31.46	99.02
L266	Tuff	48.22	0.477	21.83	4.93	0.005	3.13	1.11	0.14	5.38	0.058	11.92	97.19
L265b	Mudstone	53.50	0.861	16.33	4.17	0.063	4.56	4.41	0.95	4.33	0.096	10.02	99.29
L265a	Mudstone	45.13	0.718	13.85	3.15	0.106	6.73	9.07	0.78	3.75	0.083	15.71	99.07
L264	Tuff	51.14	0.422	20.44	4.90	0.015	3.25	1.31	0.42	5.32	0.051	10.11	97.37
L263	Mudstone	31.26	0.342	7.29	2.19	0.174	10.68	18.12	0.50	1.95	0.073	26.18	98.75
L261a	Marl	31.55	0.413	9.85	4.66	0.084	7.64	16.48	0.44	2.63	0.066	19.82	93.62
L261	Mudstone	22.33	0.214	3.94	6.31	0.169	11.07	21.82	0.26	1.00	0.046	29.11	96.28
L260	Tuff	49.37	0.355	23.26	3.22	0.006	3.53	1.90	0.05	5.76	0.064	8.16	95.66
L259b	Tuff	50.20	0.561	18.55	4.91	0.040	3.54	4.67	0.58	4.91	0.414	8.97	97.34
L259a	Marl	21.61	0.132	6.11	1.26	0.283	11.18	24.69	0.22	1.72	0.167	31.52	98.87
L256	Mudstone	54.77	0.444	19.06	4.10	0.006	2.96	1.65	0.40	4.85	0.137	8.37	96.73
L255	Tuff	54.34	0.419	22.94	3.11	0.004	3.69	0.91	0.17	5.57	0.114	7.95	99.22
L254	Mudstone	33.34	0.254	7.96	3.55	0.039	1.08	23.93	0.41	1.95	0.089	18.46	91.06

Table S2 Trace element and rare earth element compositions of the Xiakou sediments (10⁻⁶)

Sample	Lithology	Li	Be	Sc	V	Cr	Co	Ni	Cu	Zn	Ga	Rb	Sr	Y	Zr	Nb	Sn	Cs	Ba	Ta	Tl	Pb	Th	U
L278	Mudstone	44.7	2.17	9.10	83.0	45.7	9.43	21.9	32.9	70.7	16.2	89.4	192	43.4	128	21.9	2.04	5.53	178	0.77	0.49	16.6	9.62	3.49
L277	Tuff	74.8	2.09	12.0	6.25	1.51	1.41	2.18	9.61	55.7	27.7	126	91.2	40.3	602	15.9	8.15	12.0	40.0	2.28	0.19	26.5	43.7	2.62
L276	Mudstone	53.5	2.75	10.1	82.0	49.2	8.13	22.3	20.9	46.4	17.4	96.7	215	21.9	130	18.2	2.27	6.18	243	0.83	0.65	17.2	10.3	3.91
L272	Marl	23.8	1.16	5.88	38.7	18.3	7.96	18.9	22.6	32.1	7.50	41.5	309	22.2	53.7	4.97	1.42	2.64	86.3	0.36	0.69	13.4	5.46	3.21
L271	Tuff	86.3	3.03	15.8	16.5	5.16	1.58	6.03	19.1	98.2	27.8	127	115	39.5	615	18.0	8.70	11.3	65.3	2.68	0.09	15.2	53.3	3.05
L270	Marl	18.5	0.84	4.11	25.9	18.9	6.90	17.3	12.4	27.6	6.12	32.1	331	15.0	52.4	5.87	1.29	2.05	120	0.30	0.24	17.6	4.08	1.56
L268	Mudstone	69.0	2.67	13.4	87.5	63.8	19.3	44.1	23.7	85.6	20.4	131	140	21.6	159	15.7	3.15	9.37	273	1.09	0.63	27.3	13.4	2.29
L267b	Tuff	78.1	2.82	14.0	108	73.0	8.04	22.8	18.4	45.9	23.1	153	200	19.3	191	18.3	3.36	10.8	384	1.24	0.72	20.3	15.3	2.61
L267a	Mudstone	46.7	2.29	9.76	60.8	44.5	13.9	29.9	24.3	54.4	15.1	96.9	155	28.1	127	13.7	2.52	6.60	194	0.73	0.46	22.7	9.70	1.69
L266a	Mudstone	23.0	0.95	4.02	20.2	14.7	4.98	11.8	11.5	26.4	5.10	29.3	218	17.9	33.9	3.66	0.88	1.56	61.5	0.25	0.15	8.45	2.87	1.55
L266	Tuff	58.7	2.65	17.2	32.6	10.2	4.84	15.2	22.5	28.1	21.6	110	197	36.0	455	14.6	7.29	13.6	89.4	2.25	1.48	21.6	51.5	3.77
L265b	Mudstone	70.4	3.11	14.3	110	78.8	14.3	37.3	63.8	53.6	24.0	148	140	20.2	180	19.3	3.35	9.76	332	1.22	0.67	24.4	15.2	4.35
L265a	Mudstone	61.9	3.01	13.3	83.4	67.3	10.2	32.7	34.9	46.1	20.2	124	140	22.3	153	19.9	2.96	8.29	270	1.05	0.62	22.2	13.0	5.14
L264	Tuff	71.6	2.74	7.98	60.7	26.8	4.77	15.8	20.4	26.7	22.2	125	176	16.1	207	15.6	9.48	13.5	189	3.59	1.84	30.8	48.8	2.75
L263	Mudstone	31.2	1.69	6.85	43.4	30.3	7.47	19.7	12.8	37.0	10.7	61.1	157	30.9	83.3	9.83	1.70	3.66	121	0.49	0.32	10.7	7.06	3.18
L261a	Marl	36.1	1.85	8.40	46.4	32.6	5.01	16.5	18.7	62.1	13.3	79.7	250	32.4	158	13.3	3.28	5.47	165	0.84	0.59	28.0	13.8	3.11
L261	Mudstone	21.7	0.93	4.06	24.6	19.5	8.92	29.2	20.1	31.6	6.07	35.0	225	22.7	51.3	5.09	1.40	2.08	205	0.35	0.37	19.2	4.87	1.96
L260	Tuff	74.9	2.31	13.1	10.5	3.38	1.73	10.6	12.0	21.7	25.4	101	367	35.7	413	14.6	8.97	11.8	159	2.20	1.12	56.9	52.3	5.00
L259b	Tuff	93.7	3.89	12.8	123	146	10.5	68.1	39.2	79.5	30.2	134	260	45.9	297	28.7	5.24	10.6	426	1.30	1.78	32.8	24.5	6.06
L259a	Marl	29.8	1.55	3.96	73.7	26.7	3.46	21.7	10.4	31.1	9.10	43.2	283	29.1	61.8	4.82	1.63	3.25	90.9	0.38	0.27	6.19	6.37	5.35
L256	Mudstone	110	2.73	9.70	152	44.8	3.73	18.9	31.2	48.1	23.5	134	268	21.9	185	14.5	4.74	12.2	243	1.33	4.52	50.3	23.7	11.2
L255	Tuff	93.7	1.46	8.72	48.8	11.9	1.89	5.57	13.2	29.1	25.7	115	197	21.0	274	11.6	7.14	10.7	158	1.74	1.15	53.1	36.8	5.18
L254	Mudstone	32.0	1.16	4.65	38.6	20.9	3.66	18.7	14.7	41.7	8.15	49.2	904	43.3	72.5	7.71	1.39	3.99	283	0.63	0.83	26.6	7.02	6.33

(Continued)

Sample	Lithology	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	ΣREE	ΣLREE	ΣHREE
L278	Mudstone	42.6	74.6	7.66	28.0	6.04	0.95	5.85	1.08	6.86	1.51	4.78	0.74	5.05	0.77	3.10	187	160	26.6
L277	Tuff	26.8	73.4	8.80	32.7	8.14	1.38	7.63	1.36	7.59	1.41	3.68	0.48	2.77	0.38	15.3	177	151	25.3
L276	Mudstone	36.8	64.6	6.91	25.7	5.42	0.85	4.25	0.65	3.91	0.81	2.60	0.40	2.82	0.44	3.21	156	140	15.9
L272	Marl	23.4	44.9	5.03	19.7	4.20	0.70	3.87	0.62	3.57	0.73	2.19	0.31	2.08	0.32	1.43	112	97.9	13.7
L271	Tuff	37.1	96.6	11.2	40.0	8.31	1.40	7.14	1.31	7.20	1.37	3.60	0.46	2.65	0.37	16.4	219	195	24.1
L270	Marl	19.7	37.7	4.28	16.7	3.48	0.54	2.95	0.44	2.43	0.50	1.43	0.21	1.35	0.21	1.33	92.0	82.4	9.53
L268	Mudstone	34.9	66.8	7.13	26.2	4.92	0.87	3.97	0.65	3.75	0.80	2.41	0.36	2.46	0.37	4.11	156	141	14.8
L267b	Tuff	37.2	66.9	6.87	24.5	4.00	0.71	3.07	0.54	3.34	0.71	2.14	0.33	2.19	0.35	4.99	153	140	12.6
L267a	Mudstone	32.5	62.7	6.98	26.4	5.09	0.91	4.58	0.77	4.57	0.97	2.90	0.43	2.89	0.43	2.88	152	135	17.5
L266a	Mudstone	17.8	37.1	4.14	16.3	3.36	0.58	3.21	0.54	2.97	0.59	1.74	0.24	1.64	0.25	0.87	90.6	79.4	11.2
L266	Tuff	28.0	78.0	9.35	34.6	6.36	0.93	5.34	1.11	6.55	1.33	3.58	0.50	2.96	0.41	13.4	179	157	21.8
L265b	Mudstone	39.0	71.7	7.24	26.9	4.81	0.80	3.79	0.61	3.59	0.77	2.33	0.36	2.41	0.37	4.60	165	150	14.2
L265a	Mudstone	36.7	67.3	6.76	24.2	4.78	0.82	3.91	0.63	3.65	0.81	2.38	0.37	2.47	0.37	3.89	155	141	14.6
L264	Tuff	13.6	24.1	2.62	9.26	2.00	0.43	1.96	0.44	2.73	0.58	1.77	0.28	1.81	0.28	7.83	61.8	52.0	9.85
L263	Mudstone	29.1	55.9	6.21	23.9	5.15	0.68	5.01	0.89	5.19	1.08	3.09	0.48	3.17	0.47	2.11	140	121	19.4
L261a	Marl	30.4	48.1	5.30	19.4	3.95	0.64	3.82	0.68	4.45	1.05	3.22	0.50	3.31	0.51	4.36	125	108	17.5
L261	Mudstone	23.6	42.3	4.75	17.7	3.57	0.60	3.70	0.61	3.62	0.75	2.28	0.35	2.36	0.37	1.45	107	92.5	14.1
L260	Tuff	56.1	129	13.6	43.6	6.36	0.70	4.78	0.99	6.53	1.32	3.88	0.54	3.15	0.44	12.6	271	250	21.6
L259b	Tuff	45.6	94.5	12.0	46.9	10.1	1.40	9.38	1.42	7.92	1.52	4.44	0.66	4.20	0.65	7.73	241	211	30.2
L259a	Marl	23.6	44.6	5.25	20.3	4.25	0.65	4.28	0.69	3.93	0.84	2.48	0.38	2.49	0.39	1.74	114	98.6	15.5
L256	Mudstone	45.9	84.0	8.82	29.7	4.79	0.65	3.27	0.55	3.62	0.82	2.71	0.46	3.22	0.50	5.59	189	174	15.2
L255	Tuff	53.2	106	11.6	39.4	6.60	0.75	4.53	0.74	4.58	0.86	2.26	0.30	1.84	0.26	8.12	233	218	15.4
L254	Mudstone	49.2	91.8	10.5	39.0	8.07	2.19	8.04	1.33	7.76	1.54	4.33	0.63	4.09	0.62	2.06	229	201	28.3