

**Table S1** Summary of samples collected from the Pusangguo deposit in this study.

Sample no.	Type of ore	Drillhole Location	Description/Ore textures	Mineralogy
ZK004-23.4	Massive Cu-Zn ore	ZK004 at 23.4 meters	Coexisting coarse-grained Ccp and Sp; a little fine-grained Py at the margin of Sp	Ccp>Sp>Py
ZK004-79.9	Disseminated Zn-Pb ore	ZK004 at 79.9 meters	Black brown coarse-grained Sp and coarse-grained irregular galena; a little irregular Ccp as inclusions in Sp	Sp>Gn>Ccp
ZK004-90.5	Banded Pb-Zn ore	ZK004 at 90.5 meters	Light brown coarse-grained Sp and coarse-grained Gn; Gn cutting and replacing Sp; Py at the margin of Sp or in the fractures	Sp>Gn>Py
ZK002-24.5	Massive Zn-Cu ore	ZK002 at 24.5 meters	High grade Sp-Ccp ore; a small amount of late carbonate veinlets	Sp>Ccp
ZK002-66.2	Sparse disseminated Zn-Fe-Pb ore	ZK002 at 66.2 meters	Coexisting fine-grained Sp and Gn; Gn as small inclusions in Sp; Coarse euhedral Py at the margin of Gn and Sp	Sp>Gn>Sp
ZK002-86.2	Laminated Zn-Cu-Fe ore	ZK002 at 86.2 meters	Light brown coarse Sp and euhedral Py; subhedral to euhedral Py as inclusions in Ccp; a little Ccp in the fractures of Py	Sp>Ccp>Py
ZK002-109.5	Massive Cu-Fe-Zn ore	ZK002 at 109.5 meters	Coexisting coarse-grained Ccp and subhedral-euhedral Py; euhedral Py as inclusions in Ccp or Ccp in the fractures of subhedral Py; a small amount of Ccp as inclusions in Sp	Ccp>Py>Sp
ZK504-108.6	Banded Zn-Fe-Cu ore	ZK504 at 108.6 meters	Late veinlet Sp interspersed early Py-Ccp ore; coexisting euhedral Py and Ccp; partial replacement of medium- to fine grained euhedral to subhedral Py by Ccp or Sp; a little Gn as inclusions in Sp	Sp>Py>Ccp>Gn
ZK504-132.7	Veinlet Fe-Cu ore	ZK504 at 132.7 meters	Coarse euhedral Py veins and fine-grained Ccp veins occur alternately	Py>Ccp

ZK505-374.5	Disseminated Cu-Fe-Pb-Zn ore	ZK505 at 374.5 meters	Coexisting subhedral to euhedral Py and coarse-grained Ccp; a little Ccp as inclusions in Sp; partial replacement of Py by irregular Ccp	Sp>Py>Gn>Ccp
ZK001-131.7	Veinlet Fe-Zn-Pb ore	ZK001 at 131.7 meters	Early coarse subhedral to euhedral Py veins and fine-grained Sp-Gn veins occur alternately; smooth boundary between Sp and Gn	Py>Sp>Gn
ZK005-202.3	Dense disseminated Cu-Zn-Fe ore	ZK005 at 202.3 meters	Coexisting coarse-grained Ccp and fine-grained Sp; fine-grained Py at the margin of Ccp and Sp	Ccp>Sp>Py
ZK501-258.2	Veinlet Zn-Cu-Fe-Pb ore	ZK501 at 258.2 meters	Coarse-grained Ccp veins, subhedral coarse-grained Py veins and fine-grained Sp veins occur alternately; a little Gn as patchiness in Sp veins	Sp>Ccp>Py>Gn

Mineral abbreviations: Ccp-chalcopyrite, Sp-sphalerite, Py-pyrite, Gn-galena. "Mineralogy" column contains only metallic minerals and is in the order of abundance.

**Table S2** EPMA major element compositions for sphalerite from the Pusangguo deposit (wt%).

Sample	Sphalerite	As	Se	S	Pb	Bi	Ag	Fe	Co	Ni	Cu	Zn	Total
ZK002-24.5-1	SpI	0.01	0.00	33.35	0.00	0.00	0.00	5.93	0.25	0.00	0.03	60.27	99.85
ZK002-24.5-2	SpI	0.00	0.00	32.79	0.00	0.00	0.00	5.99	0.21	0.00	0.02	60.03	99.03
ZK002-24.5-3	SpI	0.01	0.09	33.19	0.00	0.00	0.00	5.49	0.21	0.00	0.00	60.10	99.10
ZK002-24.5-4	SpI	0.04	0.00	33.10	0.00	0.00	0.00	5.57	0.28	0.03	0.00	60.02	99.03
ZK002-109.5-1	SpI	0.00	0.03	33.00	0.00	0.00	0.00	6.27	0.39	0.00	0.00	59.38	99.06
ZK002-109.5-2	SpI	0.00	0.00	33.55	0.00	0.00	0.00	6.55	0.41	0.00	0.01	59.20	99.72
ZK002-109.5-3	SpI	0.00	0.00	33.24	0.00	0.00	0.00	6.62	0.40	0.01	0.00	60.08	100.35
ZK002-109.5-4	SpI	0.00	0.00	33.15	0.00	0.00	0.00	6.31	0.37	0.00	0.02	59.86	99.71
ZK004-23.4-1	SpI	0.03	0.00	33.22	0.00	0.00	0.00	6.22	0.24	0.02	0.00	60.21	99.94
ZK004-23.4-2	SpI	0.00	0.01	32.76	0.00	0.00	0.00	5.74	0.25	0.01	0.01	60.67	99.45
ZK004-23.4-3	SpI	0.00	0.04	33.31	0.00	0.00	0.00	6.86	0.22	0.00	0.03	59.15	99.58
ZK004-79.9-1	SpI	0.00	0.00	32.80	0.00	0.00	0.00	4.31	0.28	0.00	0.47	61.94	99.79
ZK004-79.9-2	SpI	0.00	0.01	33.03	0.00	0.00	0.00	4.95	0.21	0.02	0.02	61.72	99.96
ZK004-79.9-3	SpI	0.03	0.02	33.17	0.00	0.00	0.00	6.00	0.28	0.01	3.00	57.04	99.55
ZK004-79.9-4	SpI	0.02	0.00	32.80	0.00	0.00	0.00	4.38	0.28	0.00	0.43	61.86	99.76
ZK004-79.9-5	SpI	0.00	0.00	33.26	0.00	0.00	0.00	5.64	0.24	0.03	1.95	58.19	99.31
ZK005-202.3-1	SpI	0.05	0.00	33.24	0.00	0.00	0.00	6.98	0.30	0.02	0.04	60.26	100.89
ZK005-202.3-2	SpI	0.02	0.00	33.41	0.00	0.00	0.00	6.01	0.25	0.02	1.35	59.18	100.24
ZK005-202.3-3	SpI	0.01	0.01	33.25	0.00	0.00	0.00	6.71	0.24	0.04	0.17	59.45	99.88
ZK501-258.2-1	SpI	0.02	0.03	33.45	0.00	0.00	0.00	5.87	0.23	0.01	1.74	59.31	100.66
ZK501-258.2-2	SpI	0.00	0.00	33.21	0.00	0.02	0.00	6.02	0.22	0.00	0.85	59.43	99.75
ZK501-258.2-3	SpI	0.01	0.02	33.05	0.00	0.00	0.00	5.28	0.31	0.02	0.24	60.67	99.60
ZK504-108.6-1	SpI	0.00	0.00	33.19	0.00	0.00	0.00	7.22	0.28	0.00	0.87	57.68	99.24
ZK504-108.6-2	SpI	0.00	0.02	32.77	0.00	0.00	0.00	4.73	0.27	0.00	0.00	63.15	100.94

ZK504-108.6-3	SpI	0.00	0.01	33.18	0.00	0.00	0.00	4.86	0.26	0.00	0.02	61.54	99.87
ZK505-374.5-1	SpI	0.05	0.00	32.72	0.00	0.00	0.00	3.41	0.24	0.02	0.07	62.93	99.43
ZK505-374.5-2	SpI	0.02	0.02	33.13	0.00	0.00	0.00	4.62	0.26	0.00	0.04	61.66	99.75
ZK505-374.5-3	SpI	0.02	0.00	33.35	0.00	0.00	0.00	4.71	0.28	0.00	0.05	61.25	99.66
Min	SpI	0.00	0.00	32.72	0.00	0.00	0.00	3.41	0.21	0.00	0.00	57.04	99.03
Max	SpI	0.05	0.09	33.55	0.00	0.02	0.00	7.22	0.41	0.04	3.00	63.15	100.94
Median	SpI	0.01	0.00	33.19	0.00	0.00	0.00	5.90	0.26	0.00	0.04	60.09	99.73
ZK001-131.7-1	SpII	0.07	0.00	33.47	0.00	0.00	0.00	6.04	0.17	0.01	0.08	59.85	99.69
ZK001-131.7-2	SpII	0.04	0.01	33.51	0.00	0.00	0.00	4.75	0.14	0.01	0.02	60.86	99.34
ZK001-131.7-3	SpII	0.00	0.01	33.49	0.00	0.00	0.00	5.21	0.06	0.01	0.03	60.93	99.74
ZK002-66.2-1	SpII	0.05	0.00	32.95	0.00	0.00	0.00	6.24	0.00	0.07	0.00	60.42	99.72
ZK002-66.2-2	SpII	0.00	0.03	33.17	0.00	0.00	0.00	7.36	0.07	0.03	0.07	58.62	99.35
ZK002-86.2-1	SpII	0.00	0.00	33.54	0.00	0.00	0.00	6.95	0.17	0.02	0.16	59.26	100.10
ZK002-86.2-2	SpII	0.05	0.08	33.18	0.00	0.00	0.00	7.38	0.14	0.04	0.06	58.25	99.17
ZK002-86.2-3	SpII	0.00	0.00	33.25	0.00	0.00	0.00	7.98	0.14	0.07	0.18	58.18	99.79
ZK002-86.2-4	SpII	0.02	0.00	33.47	0.00	0.00	0.00	7.54	0.09	0.00	0.10	59.24	100.46
ZK002-86.2-5	SpII	0.03	0.01	33.51	0.00	0.00	0.00	7.18	0.12	0.01	0.07	59.85	100.78
ZK004-90.5-1	SpII	0.00	0.00	33.15	0.00	0.00	0.00	5.52	0.15	0.01	0.00	60.84	99.67
ZK004-90.5-2	SpII	0.01	0.02	32.89	0.00	0.00	0.00	6.13	0.12	0.01	0.01	60.02	99.21
ZK004-90.5-3	SpII	0.00	0.00	33.21	0.00	0.00	0.00	5.71	0.14	0.00	0.05	61.02	100.13
ZK004-90.5-4	SpII	0.00	0.00	33.27	0.00	0.00	0.00	5.34	0.09	0.00	0.07	60.52	99.29
ZK504-132.7-1	SpII	0.00	0.00	33.22	0.00	0.00	0.00	4.77	0.11	0.00	0.20	61.37	99.67
ZK504-132.7-2	SpII	0.01	0.00	32.83	0.00	0.00	0.00	4.70	0.15	0.00	0.11	62.12	99.91
ZK504-132.7-3	SpII	0.05	0.05	33.18	0.00	0.00	0.00	4.67	0.15	0.01	0.24	61.35	99.69
Min	SpII	0.00	0.00	32.83	0.00	0.00	0.00	4.67	0.00	0.00	0.00	58.18	99.17
Max	SpII	0.07	0.08	33.54	0.00	0.00	0.00	7.98	0.17	0.07	0.24	62.12	100.78

Median	SpII	0.01	0.00	33.22	0.00	0.00	0.00	6.04	0.14	0.01	0.07	60.42	99.69
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**Table S3** EPMA major element compositions for pyrite from the Pusangguo deposit (wt%).

Sample	Pyrite	As	Se	S	Pb	Bi	Ag	Fe	Co	Ni	Cu	Zn	Total
ZK504-132.7-1	PyI	0.00	0.06	53.58	0.00	0.00	0.00	45.51	0.03	0.00	0.13	0.03	99.34
ZK504-132.7-2	PyI	0.18	0.01	53.16	0.00	0.00	0.00	46.19	0.06	0.00	0.01	0.00	99.61
ZK504-132.7-3	PyI	0.00	0.00	52.82	0.00	0.00	0.01	46.30	0.06	0.00	0.58	0.00	99.77
ZK504-132.7-4	PyI	0.00	0.04	53.85	0.00	0.00	0.01	46.09	0.04	0.01	0.01	0.00	100.05
ZK004-90.5-1	PyI	0.22	0.00	53.51	0.00	0.00	0.00	45.65	0.04	0.01	0.04	0.03	99.50
ZK004-90.5-2	PyI	0.00	0.00	53.00	0.00	0.00	0.01	45.87	0.05	0.00	0.15	0.15	99.23
ZK004-90.5-3	PyI	0.00	0.00	53.69	0.00	0.00	0.01	46.06	0.05	0.07	0.15	0.04	100.07
ZK002-109.5-1	PyI	0.03	0.00	52.93	0.00	0.00	0.00	46.46	0.07	0.01	0.02	0.00	99.52
ZK002-109.5-2	PyI	0.02	0.00	53.87	0.00	0.00	0.01	45.27	0.09	0.00	0.03	0.01	99.30
ZK002-109.5-3	PyI	0.00	0.01	53.52	0.00	0.00	0.00	46.50	0.05	0.00	0.05	0.00	100.13
ZK002-109.5-4	PyI	0.01	0.00	55.06	0.00	0.00	0.00	45.87	0.06	0.02	0.00	0.00	101.02
ZK501-258.2-1	PyI	0.03	0.02	53.41	0.00	0.00	0.01	46.19	0.06	0.04	0.00	0.00	99.76
ZK501-258.2-2	PyI	0.07	0.00	53.48	0.00	0.00	0.00	46.39	0.02	0.02	0.01	0.00	99.99
ZK501-258.2-3	PyI	0.01	0.03	54.17	0.00	0.00	0.03	45.57	0.06	0.00	0.00	0.00	99.87
Min	PyI	0.00	0.00	52.82	0.00	0.00	0.00	45.27	0.02	0.00	0.00	0.00	99.23
Max	PyI	0.22	0.06	55.06	0.00	0.00	0.03	46.50	0.09	0.07	0.58	0.15	101.02
Median	PyI	0.01	0.00	53.52	0.00	0.00	0.01	46.08	0.06	0.01	0.03	0.00	99.77
ZK005-202.3-1	PyII	0.32	0.02	54.45	0.00	0.00	0.00	46.47	0.11	0.00	0.00	0.08	101.45
ZK005-202.3-2	PyII	0.30	0.02	53.17	0.00	0.00	0.00	45.83	0.56	0.01	0.01	0.00	99.90
ZK005-202.3-3	PyII	0.27	0.03	54.63	0.00	0.00	0.00	46.38	0.28	0.02	0.00	0.02	101.63
ZK002-66.2-1	PyII	0.07	0.00	52.75	0.00	0.00	0.00	45.93	0.28	0.13	0.00	0.00	99.16
ZK002-66.2-2	PyII	0.07	0.00	53.97	0.00	0.00	0.03	45.65	0.17	0.00	0.00	0.00	99.89
ZK002-66.2-3	PyII	0.00	0.00	54.80	0.00	0.00	0.01	44.57	0.27	0.06	0.03	0.00	99.74
ZK001-131.7-1	PyII	0.02	0.00	53.72	0.00	0.00	0.01	45.54	0.22	0.00	0.00	0.00	99.51

ZK001-131.7-2	PyII	0.01	0.00	53.51	0.00	0.00	0.03	46.29	0.19	0.01	0.00	0.01	100.05
ZK001-131.7-3	PyII	0.03	0.00	53.87	0.00	0.00	0.00	45.57	0.13	0.01	0.07	0.05	99.73
ZK505-374.5-1	PyII	0.17	0.00	53.50	0.00	0.00	0.00	46.67	0.16	0.00	0.10	0.03	100.63
ZK505-374.5-2	PyII	0.08	0.07	53.53	0.00	0.00	0.03	45.78	0.20	0.06	0.13	0.03	99.91
ZK505-374.5-3	PyII	0.00	0.00	53.63	0.00	0.00	0.00	46.05	0.18	0.04	0.00	0.03	99.93
Min	PyII	0.00	0.00	52.75	0.00	0.00	0.00	44.57	0.11	0.00	0.00	0.00	99.16
Max	PyII	0.32	0.07	54.80	0.00	0.00	0.03	46.67	0.56	0.13	0.13	0.08	101.63
Median	PyII	0.07	0.00	53.68	0.00	0.00	0.00	45.88	0.20	0.01	0.00	0.02	99.91

**Table S4** Summary of LA-ICP-MS trace elemental data (in ppm) obtained for sphalerite from the Pusangguo deposit.

Analysis spot	Sphalerite	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Ga	Ge	As	Se	Ag	Cd	In	Sn	Sb	Au	Tl	Pb	Bi
ZK002-24.5-1	SpI	1247	3.80	4.78	4252	88891	1695	4.82	1012	0.460	0.750	0.320	5.61	8.66	4587	17.0	4.18	0.228	0.034	0.054	9.36	4.29
ZK002-24.5-2	SpI	1559	0.376	4.68	3825	82357	1634	3.80	524	0.411	0.710	1.15	4.54	3.29	4557	12.2	4.28	0.092	0.020	0.019	9.54	4.67
ZK002-24.5-3	SpI	692	b.d.l	b.d.l	3934	81796	1568	3.72	1959	0.419	0.680	0.193	5.33	5.21	4502	14.1	4.05	0.143	0.100	0.009	10.5	12.3
ZK002-24.5-4	SpI	683	b.d.l	27.5	3172	81049	1215	5.69	48.0	0.820	0.670	5.12	4.40	2.35	4397	9.36	4.09	1.25	0.009	0.420	77.3	0.580
ZK002-24.5-5	SpI	708	b.d.l	b.d.l	3734	83141	1558	3.29	239	0.340	0.710	0.165	4.57	4.16	4651	15.4	3.76	0.055	0.023	0.008	25.9	3.70
ZK002-24.5-6	SpI	1503	0.041	b.d.l	3475	80420	1370	4.62	70.6	0.174	0.700	2.26	4.62	3.57	4512	8.27	3.75	b.d.l	b.d.l	b.d.l	1.58	1.47
ZK002-24.5-7	SpI	715	25.6	46.5	3965	83327	1667	3.15	2640	1.920	0.830	0.480	5.12	6.15	4361	18.8	5.35	1.25	0.106	0.189	17.0	14.0
ZK505-374.5-1	SpI	2.42	0.211	1.26	5068	57983	1518	2.52	5790	0.126	0.580	4.33	3.75	12.4	2454	4.20	3.14	1.84	0.073	0.134	1.38	1.16
ZK505-374.5-2	SpI	2.03	0.064	0.58	1853	51756	1482	2.44	597	0.272	0.420	2.79	2.92	2.39	2711	2.08	2.93	0.840	0.012	0.015	2.10	1.89
ZK505-374.5-3	SpI	1.98	b.d.l	0.790	1442	44844	1506	7.64	4506	0.092	0.450	0.215	2.77	7.98	2677	2.09	2.59	0.019	0.006	b.d.l	1.24	0.554
ZK505-374.5-4	SpI	2.40	0.076	b.d.l	4354	53622	1594	3.38	1400	0.119	0.410	0.277	2.77	3.30	2524	3.40	2.59	0.094	0.010	0.012	2.51	0.470
ZK505-374.5-5	SpI	1.75	b.d.l	0.800	1742	35839	1027	2.90	10.6	0.420	0.440	0.123	2.87	0.971	2430	0.195	2.26	0.239	0.003	0.006	2.96	0.213
ZK505-374.5-6	SpI	2.08	b.d.l	0.770	1584	33483	928	2.88	7.35	0.261	0.390	b.d.l	2.91	0.959	2403	0.103	2.95	b.d.l	b.d.l	b.d.l	0.140	0.013
ZK005-202.3-1	SpI	3730	563	118	1878	59624	3038	28.7	1907	15.6	71.2	31.0	b.d.l	11.2	2349	6.08	103	146	b.d.l	0.617	8.65	b.d.l
ZK005-202.3-2	SpI	103	0.925	0.960	2626	45961	1930	1.98	21804	0.609	0.440	0.191	3.08	15.8	2810	2.34	5.20	0.405	0.016	0.008	8.49	0.003
ZK005-202.3-3	SpI	2.10	0.011	0.560	2531	43715	2046	1.21	19970	0.379	b.d.l	0.117	2.51	13.1	2820	2.69	4.87	0.575	0.035	0.013	11.5	0.005
ZK005-202.3-4	SpI	2.63	0.280	b.d.l	2694	31656	1973	1.11	6478	0.102	0.400	0.183	2.72	18.5	2687	2.96	4.20	2.33	0.030	0.038	9.67	0.195
ZK005-202.3-5	SpI	3431	7.28	2.63	2795	44258	2103	2.04	18782	0.380	0.420	0.522	2.99	19.2	2691	2.64	4.13	1.38	0.031	0.017	11.2	0.017
ZK501-258.2-1	SpI	93.9	0.147	0.660	2292	41365	1934	1.04	20476	0.197	0.430	0.203	2.89	14.9	2803	2.54	5.61	0.910	0.083	0.019	18.1	0.005
ZK501-258.2-2	SpI	13.1	2.19	1.05	5315	43792	2051	0.940	10434	0.244	0.450	0.360	25.3	61.1	2744	2.83	7.23	19.4	0.165	0.270	25.0	1.87
ZK501-258.2-3	SpI	370	1.97	1.22	4396	47888	1937	1.90	17317	0.498	0.460	0.347	3.25	16.4	2671	2.55	5.46	0.414	0.014	0.027	11.6	0.016
ZK501-258.2-4	SpI	2.13	0.032	0.560	1832	44696	1295	6.23	1591	0.157	0.370	b.d.l	2.78	3.14	2498	0.251	2.92	0.024	b.d.l	b.d.l	0.695	0.128
ZK504-108.6-1	SpI	1.91	0.009	0.72	1530	49199	1344	9.77	7521	0.447	0.330	0.214	b.d.l	3.32	2747	0.498	6.10	0.049	0.006	0.043	5.56	3.45
ZK504-108.6-2	SpI	1.85	b.d.l	b.d.l	1946	48594	1497	1.33	1091	0.058	0.440	0.135	3.38	2.45	2552	4.19	5.36	0.085	0.363	0.032	3.19	2.38



ZK504-108.6-3	SpI	2.29	b.d.l	b.d.l	1749	48905	1577	4.72	3853	0.258	0.410	0.163	217	1806	2792	2.67	6.47	0.676	0.025	15.4	2.82	1.97
ZK504-108.6-4	SpI	2.09	b.d.l	b.d.l	1943	45798	1525	1.33	312	0.168	0.380	b.d.l	2.8	1.37	2576	5.99	4.59	0.013	0.014	0.006	5.67	2.28
ZK504-108.6-5	SpI	2.18	b.d.l	b.d.l	1735	53191	1493	8.59	7118	0.178	b.d.l	0.110	2.13	14.7	2741	1.48	4.59	0.040	0.007	0.007	5.72	2.46
ZK004-23.4-1	SpI	3.42	0.184	0.930	2307	51804	1441	1.50	3402	0.446	0.590	0.232	2.94	4.89	2672	2.24	4.30	0.173	0.038	0.028	6.32	8.81
ZK004-23.4-2	SpI	2.18	b.d.l	b.d.l	1638	37565	1169	4.13	90.6	0.489	0.570	0.137	2.80	1.18	2549	0.098	3.74	0.049	b.d.l	0.017	0.570	0.059
ZK004-23.4-3	SpI	2.59	0.138	0.580	4160	56696	1566	2.08	1296	0.409	0.480	b.d.l	2.89	2.11	2554	1.28	3.88	0.106	b.d.l	0.005	3.05	1.29
ZK004-23.4-4	SpI	1.80	b.d.l	0.580	1684	42870	1275	2.64	279	0.279	0.450	b.d.l	3.03	1.61	2520	0.328	3.61	0.018	b.d.l	b.d.l	0.491	0.219
ZK004-23.4-5	SpI	1.88	b.d.l	b.d.l	1436	35268	1149	2.29	7.58	0.262	b.d.l	0.102	b.d.l	0.987	2392	0.122	3.24	b.d.l	b.d.l	b.d.l	0.135	0.090
ZK004-23.4-6	SpI	1.76	b.d.l	0.570	1734	45041	1148	6.64	2345	0.317	0.330	b.d.l	2.91	4.24	2570	0.504	3.08	b.d.l	0.004	0.002	4.93	0.711
ZK004-79.9-1	SpI	2.21	b.d.l	b.d.l	2308	32536	1985	1.13	7302	0.072	0.410	0.192	2.92	13.4	2795	3.08	7.33	0.790	0.044	0.009	2.45	0.060
ZK004-79.9-2	SpI	1808	4.97	0.820	2669	34631	1920	3.91	11380	0.568	4.350	7.71	28.6	41.4	2701	3.03	8.71	8.87	0.017	0.142	1.27	3.11
ZK004-79.9-3	SpI	2.40	b.d.l	0.590	2425	41236	1973	1.85	15875	0.333	0.440	0.165	3.03	21.0	2875	1.92	7.04	0.088	0.014	b.d.l	3.81	0.003
ZK004-79.9-4	SpI	2.23	b.d.l	0.720	2422	35128	2006	1.09	9287	0.105	0.400	0.145	2.82	12.2	2817	2.95	6.21	0.300	0.072	0.009	9.43	0.011
ZK004-79.9-5	SpI	164	0.75	11.6	3304	35615	2017	1.24	8428	0.169	0.410	0.209	2.75	17.8	2731	2.99	5.65	0.473	0.064	0.037	9.71	0.018
ZK002-109.5-1	SpI	923	0.019	b.d.l	3508	84634	1572	4.39	163	0.490	0.670	b.d.l	4.36	2.96	4540	6.71	3.51	b.d.l	0.024	b.d.l	4.36	3.17
ZK002-109.5-2	SpI	558	0.023	b.d.l	3399	78581	1416	3.96	88.5	0.550	0.720	b.d.l	4.55	2.60	4331	12.5	3.38	0.053	0.015	0.008	3.58	1.85
ZK002-109.5-3	SpI	760	0.163	b.d.l	3217	76605	1102	5.49	68.0	1.00	0.680	0.510	6.33	2.45	4279	42.7	3.19	0.352	b.d.l	0.021	2.32	1.36
ZK002-109.5-4	SpI	753	b.d.l	b.d.l	3638	82471	1569	3.14	2048	0.670	0.730	b.d.l	4.57	6.99	4471	15.1	3.09	0.217	0.081	0.004	11.0	10.4
ZK002-109.5-5	SpI	671	b.d.l	b.d.l	3956	83497	1682	4.08	220	0.440	0.700	0.210	b.d.l	2.97	4572	9.16	3.26	b.d.l	0.013	b.d.l	2.83	2.15
ZK002-109.5-6	SpI	2233	0.510	1.52	3061	77977	1181	4.69	92.1	0.970	0.790	0.224	4.52	3.73	4359	18.1	3.11	0.141	0.027	0.029	7.29	3.61
ZK001-131.7-1	SpII	1.99	b.d.l	1.59	3821	52665	80.1	4.75	1931	0.753	0.300	0.190	b.d.l	3.82	2800	10.7	16.9	0.057	0.048	0.009	125	12.6
ZK001-131.7-2	SpII	2.19	0.020	2.33	3645	53764	130	5.83	3899	0.823	0.470	0.151	3.43	5.84	2686	9.58	14.2	0.058	0.041	0.029	189	12.1
ZK001-131.7-3	SpII	1.94	b.d.l	1.27	3678	50392	109	2.87	47.5	0.603	0.420	b.d.l	2.56	1.45	2675	13.6	13.3	0.030	0.017	0.003	2.77	4.34
ZK001-131.7-4	SpII	2.20	b.d.l	1.98	3521	49831	169	1.68	26.5	0.525	0.450	0.140	3.06	2.11	2776	10.1	12.3	b.d.l	0.029	0.006	8.79	4.11
ZK001-131.7-5	SpII	2.34	b.d.l	0.640	3558	53500	136	4.85	2089	0.800	0.440	b.d.l	2.74	3.27	2769	13.0	12.5	0.034	0.011	0.004	2.85	1.91
ZK001-131.7-6	SpII	2.18	b.d.l	0.920	2912	54590	362	2.62	215	0.868	0.420	b.d.l	2.74	1.68	2908	9.47	12.0	b.d.l	0.006	b.d.l	2.44	1.63

ZK002-66.2-1	SpII	634	b.d.l	1.69	3318	71970	739	4.15	35.0	0.730	0.870	0.153	4.31	2.39	4270	8.38	4.30	b.d.l	0.013	0.004	2.06	1.78
ZK002-66.2-2	SpII	684	0.550	1.83	4185	72697	608	4.67	59.5	0.440	0.730	0.660	4.35	2.09	4327	21.2	4.08	0.408	0.042	0.021	2.19	0.98
ZK002-66.2-3	SpII	640	0.116	2.42	3193	68515	761	4.92	20.5	0.570	0.670	0.490	4.43	2.31	4268	12.2	3.53	0.109	b.d.l	0.011	1.71	1.19
ZK002-66.2-4	SpII	645	b.d.l	1.59	3999	71836	540	1.68	88.4	0.580	0.740	b.d.l	4.36	4.45	4463	18.5	3.32	0.082	0.051	0.005	67.4	10.0
ZK002-66.2-5	SpII	633	0.079	b.d.l	4171	77489	443	6.46	462	0.960	0.650	0.203	4.27	2.78	4733	18.5	3.55	0.164	0.029	b.d.l	2.74	1.59
ZK002-66.2-6	SpII	614	0.048	6.22	3346	61181	269	1.85	91.3	0.870	0.620	0.148	4.01	7.04	4164	10.5	3.11	0.141	0.101	0.006	17.7	13.2
ZK002-66.2-7	SpII	630	0.019	1.71	6397	80661	159	6.37	1508	1.84	0.720	b.d.l	4.65	4.76	4978	18.6	2.89	0.073	0.044	b.d.l	5.23	9.47
ZK002-66.2-8	SpII	600	0.020	b.d.l	6231	81548	168	11.4	5912	1.54	0.750	0.205	4.72	5.66	4831	21.0	3.12	b.d.l	0.022	b.d.l	6.33	7.17
ZK002-66.2-9	SpII	655	b.d.l	1.91	6336	77708	149	6.87	1967	1.24	0.750	b.d.l	4.76	4.18	5001	36.2	3.09	0.074	0.018	b.d.l	1.85	1.83
ZK002-66.2-10	SpII	618	0.095	b.d.l	6443	78935	144	7.31	2400	1.61	0.930	0.340	4.82	3.78	5020	27.0	3.23	b.d.l	0.019	b.d.l	3.82	3.08
ZK002-66.2-11	SpII	5837	1.38	8.43	4454	80503	949	3.15	270	0.750	0.740	0.600	4.90	3.57	4338	18.7	2.90	0.47	0.051	0.023	5.54	5.35
ZK002-86.2-1	SpII	2.25	b.d.l	3.07	2735	54916	429	2.33	20.2	0.805	0.410	0.223	2.80	1.59	2720	10.6	11.3	0.013	0.005	0.009	4.34	1.67
ZK002-86.2-2	SpII	2.23	b.d.l	1.28	2110	54300	615	3.42	635	0.600	0.410	b.d.l	2.78	2.40	2621	8.81	10.2	0.020	b.d.l	0.006	35.8	13.7
ZK002-86.2-3	SpII	14.1	0.248	1.15	2114	52555	653	2.50	21.0	0.585	0.380	0.137	2.63	1.47	2665	7.79	9.47	0.042	0.010	0.010	3.50	1.41
ZK002-86.2-4	SpII	2.27	b.d.l	2.91	2091	53572	721	2.90	24.0	0.252	0.350	0.123	2.71	1.63	2615	5.58	8.84	0.019	0.012	0.003	3.67	1.34
ZK002-86.2-5	SpII	2.08	b.d.l	2.83	1882	52546	694	1.96	50.0	0.199	b.d.l	0.273	2.56	1.74	2459	8.64	8.32	0.016	0.018	0.015	3.26	1.28
ZK002-86.2-6	SpII	95.7	7.04	37.5	2351	54317	730	1.92	639	0.395	0.480	0.890	3.35	5.03	2608	9.70	7.10	0.260	0.024	0.041	127	12.9
ZK002-86.2-7	SpII	2.04	0.009	3.46	2045	51128	724	2.37	510	0.132	0.400	0.125	4.94	3.01	2527	7.37	7.50	0.065	0.053	0.007	9.23	6.21
ZK002-86.2-8	SpII	2.24	0.039	2.66	2337	54822	834	2.77	73.7	0.123	0.410	0.125	3.20	1.48	2678	11.7	7.18	b.d.l	0.008	0.009	12.5	1.28
ZK002-86.2-9	SpII	1.86	b.d.l	4.66	2401	51313	829	2.56	3739	0.103	0.390	0.164	3.20	8.44	2673	9.22	6.88	0.244	0.105	0.018	89.4	16.5
ZK002-86.2-10	SpII	2.14	b.d.l	1.65	2269	55828	838	2.99	412	0.165	0.370	b.d.l	2.71	2.60	2677	8.94	7.33	0.028	0.012	0.026	5.20	1.84
ZK004-90.5-1	SpII	1.99	b.d.l	b.d.l	1677	34260	886	3.20	9.28	0.320	0.430	0.211	2.72	0.997	2414	0.187	2.49	b.d.l	0.003	b.d.l	0.226	0.021
ZK004-90.5-2	SpII	2.11	b.d.l	0.560	1670	34058	931	2.90	9.57	0.513	0.380	0.192	2.72	0.890	2375	0.251	2.55	b.d.l	0.005	0.004	0.665	0.193
ZK004-90.5-3	SpII	1.57	0.006	b.d.l	1856	32571	705	2.31	9.25	0.502	b.d.l	0.113	1.89	0.999	2334	0.195	2.30	0.017	b.d.l	b.d.l	1.61	0.644
ZK004-90.5-4	SpII	1.82	b.d.l	0.530	1642	32909	876	2.87	7.58	0.217	0.360	b.d.l	2.74	0.904	2374	0.080	2.22	b.d.l	b.d.l	0.003	0.526	0.036
ZK504-132.7-1	SpII	1.97	b.d.l	0.87	1456	53258	886	25.8	29286	0.483	0.450	0.176	34.1	7.31	3056	46.3	17.4	0.058	0.021	0.019	115	16.9

ZK504-132.7-2	SpII	2.46	0.169	0.63	1407	56490	843	24.9	33121	0.455	0.380	0.755	36.3	10.1	2960	47.8	15.9	0.093	0.036	0.040	379	258
ZK504-132.7-3	SpII	2.27	b.d.l	1.42	1342	57277	756	87.4	27833	0.381	0.320	b.d.l	34.0	15.7	2884	39.6	14.0	0.245	0.069	0.012	1.09	0.702
ZK504-132.7-4	SpII	2.06	b.d.l	0.65	1362	46826	784	67.8	20054	0.338	0.440	0.238	33.8	9.14	2812	36.8	12.3	0.066	0.235	0.013	3.12	6.40
ZK504-132.7-5	SpII	116	1.83	1.18	1324	58089	820	35.1	30411	0.518	0.350	0.200	34.8	4.3	2896	47.0	12.4	0.058	0.027	0.030	12.1	7.39
ZK504-132.7-6	SpII	2.18	b.d.l	b.d.l	1317	47612	766	73.0	18005	0.379	0.390	0.110	33.2	9.91	2841	37.6	10.8	0.052	0.056	0.008	5.22	6.36
ZK504-132.7-7	SpII	16.9	0.759	0.92	1403	42136	802	42.4	15951	0.475	0.310	0.538	33.2	6.32	2860	39.7	9.92	0.066	0.064	0.007	75.2	11.6
ZK504-132.7-8	SpII	2.43	b.d.l	b.d.l	1507	38895	817	42.1	10172	0.280	0.420	b.d.l	36.1	6.10	2889	36.3	9.18	0.055	0.032	0.017	107	17.0

The abbreviations "b.d.l" stands for "below detection limit".

**Table S5** Summary of LA-ICP-MS trace elemental data (in ppm) obtained for pyrite from the Pusangguo deposit.

Analysis spot	Pyrite	Ti	V	Cr	Mn	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Ag	Cd	In	Sn	Sb	Au	Tl	Pb	Bi
ZK501-258.2-1	PyI	2623	47.2	7.46	24.7	0.590	0.850	1.20	4.51	26.6	8.54	253	22.0	0.982	0.44	2.06	1.32	0.870	0.148	0.018	1.37	b.d.l
ZK501-258.2-2	PyI	1663	45.3	8.37	15.2	0.570	0.650	0.900	4.58	31.0	9.97	258	20.6	1.16	0.59	1.53	0.640	3.51	0.139	b.d.l	1.23	b.d.l
ZK501-258.2-3	PyI	598	30.7	3.41	12.7	0.880	0.860	0.750	10.8	21.5	18.6	568	b.d.l	2.14	0.479	7.12	0.500	1.49	0.197	b.d.l	1.31	0.152
ZK501-258.2-4	PyI	1353	47.3	b.d.l	12.6	0.590	0.920	0.870	3.85	28.7	13.2	233	22.2	1.20	0.770	1.92	0.360	0.590	0.039	0.026	0.919	b.d.l
ZK501-258.2-5	PyI	454	12.9	b.d.l	9.56	0.400	0.530	0.560	35.01	15.6	11.4	1968	b.d.l	0.114	0.959	4.79	0.510	0.302	0.431	0.015	17.0	0.074
ZK501-258.2-6	PyI	8874	129	53.4	9.03	0.980	0.930	1.06	10.8	30.4	22.3	75.7	25.3	2.22	0.670	1.55	b.d.l	0.279	0.047	0.069	1.48	b.d.l
ZK002-109.5-1	PyI	1100	43.2	b.d.l	188	0.620	0.600	0.710	4.29	24.3	15.2	477	16.7	0.189	0.532	2.26	b.d.l	0.275	2.03	b.d.l	26.1	0.491
ZK002-109.5-2	PyI	1684	48.5	6.56	6.58	1.560	0.740	0.820	62.9	31.3	16.6	2156	20.4	1.16	0.680	4.46	0.370	0.197	0.229	0.029	3.15	b.d.l
ZK002-109.5-3	PyI	1240	44.8	b.d.l	11.5	0.510	0.680	0.830	4.54	31.5	9.43	271	18.6	2.14	0.461	1.62	0.350	0.412	1.22	b.d.l	1.20	0.040
ZK002-109.5-4	PyI	2878	84.4	8.21	5.05	1.370	1.38	0.820	45.8	27.3	14.2	226	19.0	3.16	0.529	1.89	b.d.l	0.530	0.022	b.d.l	1.56	0.242
ZK002-109.5-5	PyI	2078	64.3	8.27	6.75	0.620	0.820	0.880	7.23	29.3	15.7	1417	b.d.l	3.18	0.606	3.41	2.30	1.34	1.03	b.d.l	2.20	0.034
ZK002-109.5-6	PyI	97.4	0.019	0.72	3.47	278	1.38	12.8	85.2	0.099	b.d.l	4565	12.6	2.36	0.365	0.007	0.30	0.880	1.02	0.017	268	19.6
ZK504-132.7-1	PyI	6597	180	6513	4.61	1.03	0.690	11.8	86.8	26.1	19.2	186	20.1	0.296	0.740	1.70	b.d.l	0.165	3.03	b.d.l	16	1.18
ZK504-132.7-2	PyI	1072	35.1	16.8	4.90	0.730	0.910	0.720	33.3	29.2	16.3	2377	18.2	2.15	0.725	5.16	b.d.l	0.940	4.03	0.016	2.01	0.028
ZK504-132.7-3	PyI	3018	71.0	39.3	b.d.l	0.690	0.970	0.930	17.5	31.0	9.44	288	b.d.l	3.18	0.430	1.33	b.d.l	1.04	2.03	0.058	0.988	0.026
ZK504-132.7-4	PyI	1404	46.5	20.5	3.00	1.38	0.720	0.810	45.7	26.5	18.6	1403	b.d.l	3.15	0.587	5.22	b.d.l	0.790	3.22	0.022	26.3	0.033
ZK504-132.7-5	PyI	116	b.d.l	b.d.l	16.8	3.18	0.940	0.910	14.1	30.2	32.8	176	42.3	3.68	332	20.6	0.270	0.700	1.84	14.9	26.6	7.84
ZK504-132.7-6	PyI	5569	69.2	27.9	9.45	0.71	0.900	1.01	16.5	28.2	14.7	146	24.4	1.67	0.810	1.63	b.d.l	1.38	1.03	b.d.l	41.3	19.6
ZK004-90.5-1	PyI	457	33.4	7.43	2.61	0.500	0.680	0.700	20.5	24.0	21.9	360	b.d.l	0.877	0.495	6.38	b.d.l	0.466	2.03	b.d.l	9.71	5.91
ZK004-90.5-2	PyI	2001	45.6	7.81	11.0	0.590	0.870	0.850	8.22	28.3	10.5	308	20.7	1.17	0.583	1.77	0.740	1.24	1.13	b.d.l	1.07	0.234
ZK004-90.5-3	PyI	5126	61.4	15.7	4.09	0.650	0.780	0.880	5.19	31.4	15.1	784	22.8	0.974	0.550	2.46	b.d.l	0.910	3.44	0.016	1.44	b.d.l
ZK004-90.5-4	PyI	3463	63.9	7.89	3.54	0.650	0.800	0.850	9.43	27.2	15.3	215	b.d.l	1.19	0.600	1.87	b.d.l	11.2	2.27	b.d.l	14.2	b.d.l
ZK004-90.5-5	PyI	3059	114	10.8	30.2	0.650	0.800	0.910	13.0	26.7	14.9	186	22.4	0.378	0.590	1.62	b.d.l	0.830	3.04	0.018	1.65	0.212
ZK004-90.5-6	PyI	4676	344	7.70	1.72	0.650	0.840	0.910	4.35	32.9	17.6	100	22.9	0.883	0.570	1.49	b.d.l	0.211	2.04	b.d.l	3.11	b.d.l

ZK002-66.2-1	PyII	21.3	1.33	3.70	21272	824	8.61	352	3492	1.24	1.43	860	22.6	0.630	17.6	0.970	13.8	1.31	0.027	0.053	2.89	1.32
ZK002-66.2-2	PyII	17.0	0.77	b.d.l	17401	889	9.32	45.3	2136	0.780	2.24	898	21.3	2.460	11.1	0.465	14.0	1.66	0.402	0.263	104	29.6
ZK002-66.2-3	PyII	18.4	0.81	2.64	17575	818	14.3	29.0	2755	0.880	b.d.l	787	20.6	2.650	8.82	0.540	10.5	1.69	0.068	0.057	392	47.2
ZK002-66.2-4	PyII	16.2	0.31	4.20	20735	911	7.08	22.0	1223	0.540	1.55	513	22.1	0.223	6.94	0.263	14.1	1.71	0.298	0.047	35.1	9.4
ZK002-66.2-5	PyII	17.5	0.491	3.19	8590	1281	11.5	13.8	1682	0.480	1.64	869	24.9	7.46	10.1	0.323	9.13	1.96	0.213	0.043	770	33.7
ZK002-66.2-6	PyII	15.8	0.229	b.d.l	32797	608	14.7	3.78	1005	0.407	1.55	248	b.d.l	0.214	11.9	0.258	16.9	0.689	0.287	0.011	1.01	0.304
ZK005-202.3-1	PyII	23.6	0.468	3.83	13756	820	21.3	16.1	1269	0.360	1.56	206	b.d.l	0.136	5.98	0.341	11.2	1.43	0.359	0.013	4.69	1.89
ZK005-202.3-2	PyII	16.1	0.215	3.12	15774	784	42.9	6.17	510	0.297	1.56	1008	25.6	0.205	5.56	0.092	11.4	2.10	0.312	b.d.l	17.7	4.32
ZK005-202.3-3	PyII	15.0	0.31	4.44	16924	1865	142	29.0	690	0.300	1.41	5871	129	182	3.52	0.348	12.1	1.77	1.27	1.15	49.9	673
ZK005-202.3-4	PyII	15.5	0.144	b.d.l	21991	485	12.8	14.4	806	0.295	1.40	12763	b.d.l	5.26	3.36	0.211	11.7	1.73	5.22	0.04	642	57.0
ZK005-202.3-5	PyII	70.1	41.6	42.7	21273	452	108	28.5	245	0.191	1.32	14086	199	1177	8.71	0.073	10.8	1.60	1.43	5.68	83.4	44.0
ZK005-202.3-6	PyII	15.7	0.227	4.40	1.46	560	22.8	29.3	885	0.211	1.49	10549	45.9	1.36	6.39	0.153	b.d.l	0.149	5.31	0.102	92.3	7.84
ZK505-374.5-1	PyII	14.2	0.132	b.d.l	30743	709	32.4	11.6	267	0.087	1.48	8080	65.0	0.376	2.64	0.085	12.7	1.16	2.60	b.d.l	27.6	3.80
ZK505-374.5-2	PyII	71.3	0.342	2.52	12572	736	34.0	10.4	303	0.153	1.43	4752	47.6	0.560	3.02	0.092	9.69	2.67	0.462	0.013	67.9	12.6
ZK505-374.5-3	PyII	17.1	0.147	b.d.l	19167	1348	1874	361	b.d.l	0.240	2.01	11414	155	1157	b.d.l	b.d.l	12.3	1.54	4.20	5.26	58.1	43.8
ZK505-374.5-4	PyII	14.5	0.120	3.54	19204	2189	283	12.7	238	0.185	1.41	5749	b.d.l	1.47	3.71	0.099	10.8	1.85	1.76	0.017	273	39.9
ZK505-374.5-5	PyII	18.7	0.333	b.d.l	6608	3397	365	828	3509	0.244	b.d.l	2076	43.8	300	20.8	1.03	b.d.l	115	0.296	1.55	104	94.1
ZK505-374.5-6	PyII	403	4.42	7.34	25707	526	56.4	11.1	813	0.321	1.42	6947	b.d.l	1.36	3.20	0.128	11.6	0.706	3.84	0.054	146	27.5
ZK001-131.7-1	PyII	15.5	0.13	b.d.l	20341	805	50.0	19.2	515	0.187	1.29	15350	61.9	9.83	3.04	0.210	9.89	1.24	11.7	0.062	623	95.4
ZK001-131.7-2	PyII	15.3	6.38	16.0	16506	850	39.2	14.5	474	0.113	1.36	9489	39.0	8.40	2.35	0.199	10.4	1.64	4.51	0.065	623	117
ZK001-131.7-3	PyII	14.8	0.131	6.08	17626	587	23.3	39.8	176	0.289	1.46	7275	64.6	6.73	2.71	0.061	11.2	2.26	2.18	0.065	544	104
ZK001-131.7-4	PyII	15.7	0.215	2.41	23970	817	13.9	41.6	2107	0.121	1.52	6941	54.4	4.68	2.87	0.054	10.7	1.49	1.61	0.730	42.8	7.13
ZK001-131.7-5	PyII	14.8	0.101	b.d.l	25143	599	24.0	32.0	338	b.d.l	1.36	9518	47.2	28.0	1.48	0.059	10.3	1.95	2.85	0.372	3945	199
ZK001-131.7-6	PyII	14.8	0.075	b.d.l	28091	403	9.25	29.8	202	b.d.l	1.41	21386	38.1	1.29	2.50	0.263	11.3	0.789	13.6	0.012	101	22.0

The abbreviations "b.d.l" stands for "below detection limit".