Table S1. Detailed EPMA compositions of the pyrite and arsenopyrite from the Wangzhuang gold deposit(wt%).

Sampling location	mineral	Au	Ag	Co	Ni	S	Te	Sb	Pb	As	Se	Cu	Fe	Zn	Total
ZK7-2	Py4	0.07	bdl	0.09	bdl	53.49	bdl	0.03	bdl	0.45	bdl	0.03	46.03	bdl	100.18
ZK7-2	Py4	0.01	0.04	0.26	0.28	53.33	bdl	0.01	0.19	0.04	bdl	0.14	44.73	0.03	99.07
ZK7-2	Py4	0.01	bdl	0.09	0.01	52.83	0.05	bdl	bdl	0.58	bdl	0.02	45.37	bdl	98.96
ZK7-2	Py4	bdl	0.01	0.12	bdl	53.12	0.02	bdl	bdl	0.47	bdl	0.01	45.53	bdl	99.27
ZK7-2	Py3	0.2	bdl	0.06	0.04	51.57	bdl	0.07	bdl	2.95	bdl	bdl	45.41	0.02	100.32
ZK7-2	Py3	0.15	bdl	0.08	0.03	45.21	bdl	bdl	bdl	10.38	bdl	0.03	43.94	bdl	99.81
ZK7-3	Py3	0.14	bdl	0.03	0.05	50.96	bdl	bdl	0.08	3.59	bdl	bdl	44.93	bdl	99.79
ZK7-2	Py3	0.09	bdl	0.06	0.27	53.64	0.02	bdl	bdl	1.42	bdl	bdl	43.18	0.09	98.77
ZK15-1	Py3	0.09	0.01	0.04	0.03	51.30	bdl	0.02	0.04	4.53	bdl	bdl	45.17	0.02	101.26
ZK103-1	Py3	0.08	bdl	0.06	0.08	53.63	bdl	0.03	0.01	1.35	bdl	0.02	45.03	0.02	100.30
ZK103-1	Py3	0.06	0.01	0.07	0.02	53.51	0.06	bdl	bdl	1.49	bdl	bdl	45.34	bdl	100.55
ZK7-2	Py3	0.05	bdl	0.03	0.24	51.70	bdl	0.05	bdl	3.50	bdl	bdl	45.09	bdl	100.66
ZK7-2	Py3	0.05	0.01	0.17	0.6	51.93	0.01	0.04	bdl	2.22	bdl	bdl	44.66	bdl	99.69
ZK103-1	Py3	bdl	bdl	0.05	0.03	52.60	0.01	bdl	bdl	2.16	bdl	bdl	45.56	bdl	100.41
ZK7-2	Apy	0.25	0.02	0.01	0.02	20.42	0.01	0.01	0.05	43.26	bdl	bdl	34.81	bdl	98.87
ZK103-1	Apy	0.16	bdl	0.03	0.01	21.99	bdl	bdl	bdl	42.42	bdl	bdl	35.68	bdl	100.30
ZK15-1	Apy	0.15	0.02	0.03	bdl	22.45	0.03	bdl	bdl	42.39	bdl	0.01	35.52	0.03	100.64
ZK103-1	Apy	0.15	bdl	0.04	0.04	22.36	0.05	bdl	0.06	42.32	bdl	0.05	35.19	bdl	100.26
ZK103-1	Apy	0.05	0.03	0.03	0.02	21.17	0.06	0.04	bdl	42.96	bdl	bdl	35.24	0.02	99.61
ZK15-1	Apy	0.03	bdl	0.04	0.02	21.30	bdl	0.03	0.04	42.96	bdl	bdl	35.72	0.03	100.17
ZK103-1	Apy	0.02	0.02	0.04	bdl	21.95	0.01	0.02	bdl	42.30	bdl	bdl	35.10	0.03	99.49
ZK7-2	Apy	bdl	bdl	0.05	0.05	26.13	bdl	bdl	0.02	36.41	bdl	bdl	36.84	0.02	99.53
ZK11-1	Py2	bdl	bdl	0.17	0.53	53.41	bdl	bdl	bdl	0.11	0.01	0.04	44.23	0.06	98.55
ZK103-1	Py2	bdl	bdl	0.16	0.45	53.89	bdl	bdl	bdl	0.09	bdl	bdl	45.88	0.02	100.49
ZK7-2	Py2	bdl	bdl	0.05	bdl	54.33	0.04	0.03	bdl	0.03	bdl	bdl	45.75	0.01	100.25
ZK11-1	Py1	bdl	bdl	0.14	0.2	54.69	0.01	bdl	0.1	0.01	bdl	bdl	46.10	bdl	101.25
ZK15-1	Py1	bdl	bdl	0.02	bdl	54.46	bdl	0.02	0.01	bdl	bdl	bdl	46.21	bdl	100.71

Note: bdl-below the detection limit.

Table S2. Detailed LA-MC-ICP-MS In-situ S isotopic compositions of pyrite and arsenopyrite from the Wangzhaung gold deposit.

Sample Number	Pyrite type	$\delta^{34}S$ (‰)
ZK7-2TZ5	Py4	0.3
ZK7-2TZ4	Py4	4.1
ZK7-2TZ2	Py4	2.1
ZK7-1TZ1	Py4	5.3
ZK7-2TZ4	Py3	11.2
ZK7-2TZ4	Py3	10.3
ZK7-2TZ4	Py3	9.9
ZK7-2TZ2	Py3	9.4
Zk7-1TZ4	Py3	10
ZK7-1TZ3	Py3	9.7
ZK7-1TZ1	Py3	8.7
ZK15-1TZ2(1)	Py3	10.4
ZK15-1TZ2(1)	Py3	10.3
ZK15-1TZ2(1)	Py3	10.2
ZK15-1TZ2(1)	Py3	10.2
ZK15-1TZ2(1)	Py3	10
ZK103-1TZ4(2)	Py3	9.8
ZK103-1TZ4(2)	Py3	9.6
ZK103-1TZ4(2)	Py3	9.6

ZK103-1TZ4(2)	Py3	9.6
ZK103-1TZ4(2)	Py3	9.5
ZK103-1TZ4(2)	Py3	9.4
ZK103-1TZ4(2)	Py3	9.4
ZK103-1TZ3	Py3	8.4
ZK103-1TZ3	Py3	7.4
ZK103-1TZ3	Py3	5.5
ZK103-1TZ2(2)	Py3	8.8
ZK103-1TZ2(2)	Py3	7.9
ZK7-1TZ3	Apy	10.9
ZK7-1TZ3	Apy	10.4
ZK7-1TZ3	Apy	10.4
zk7-1TZ2	Apy	9.7
zk7-1TZ2	Apy	9.5
zk7-1TZ2	Apy	9.4
zk7-1TZ2	Apy	9.32
zk7-1TZ2	Apy	9.2
zk7-1TZ2	Apy	9.1
zk7-1TZ2	Apy	9.1
zk7-1TZ2	Apy	9
zk7-1TZ2	Apy	8.9
zk7-1TZ2	Apy	8.9
zk7-1TZ2	Apy	8.8
zk7-1TZ2	Apy	8.8
zk7-1TZ2	Apy	8.5
zk7-1TZ2	Apy	8.4
ZK7-1TZ1	Apy	10.3
ZK7-1TZ1	Apy	9.8
ZK7-1TZ1	Apy	9.2
ZK7-1TZ1	Apy	9.2
ZK7-1TZ1	Apy	8.8
ZK7-1TZ1	Apy	8.5
ZK7-1TZ1	Apy	8.5
ZK7-2TZ4	Py2	15.8
ZK7-1TZ1	Py2	18.2
ZK15-1TZ2(1)	Py2	28.7
ZK15-1TZ2(1)	Py2	27.9
ZK15-1TZ2(1)	Py2	27.8
ZK15-1TZ2(1)	Py2	26.7
ZK15-1TZ2(1)	Py2	25.9
ZK103-1TZ4(2)	Py2	24.3
ZK103-1TZ4(2)	Py2	23.4
ZK103-1TZ4(2)	Py2	21.8
ZK103-1TZ4(2)	Py2	18.7
ZK103-1TZ4(2)	Py2	17.7
ZK103-1TZ4(2)	Py2	17.6
ZK103-1TZ4(2)	Py2	17.5
ZK103-1TZ4(2)	Py2	17.1
ZK7-1TZ1	Py1	31.2