

FIGURE S1. Representative reflected light photomicrograph of Maluntou sulfides. Abbreviations: Sp = sphalerite, Ccp = chalcopyrite, Gn = galena.

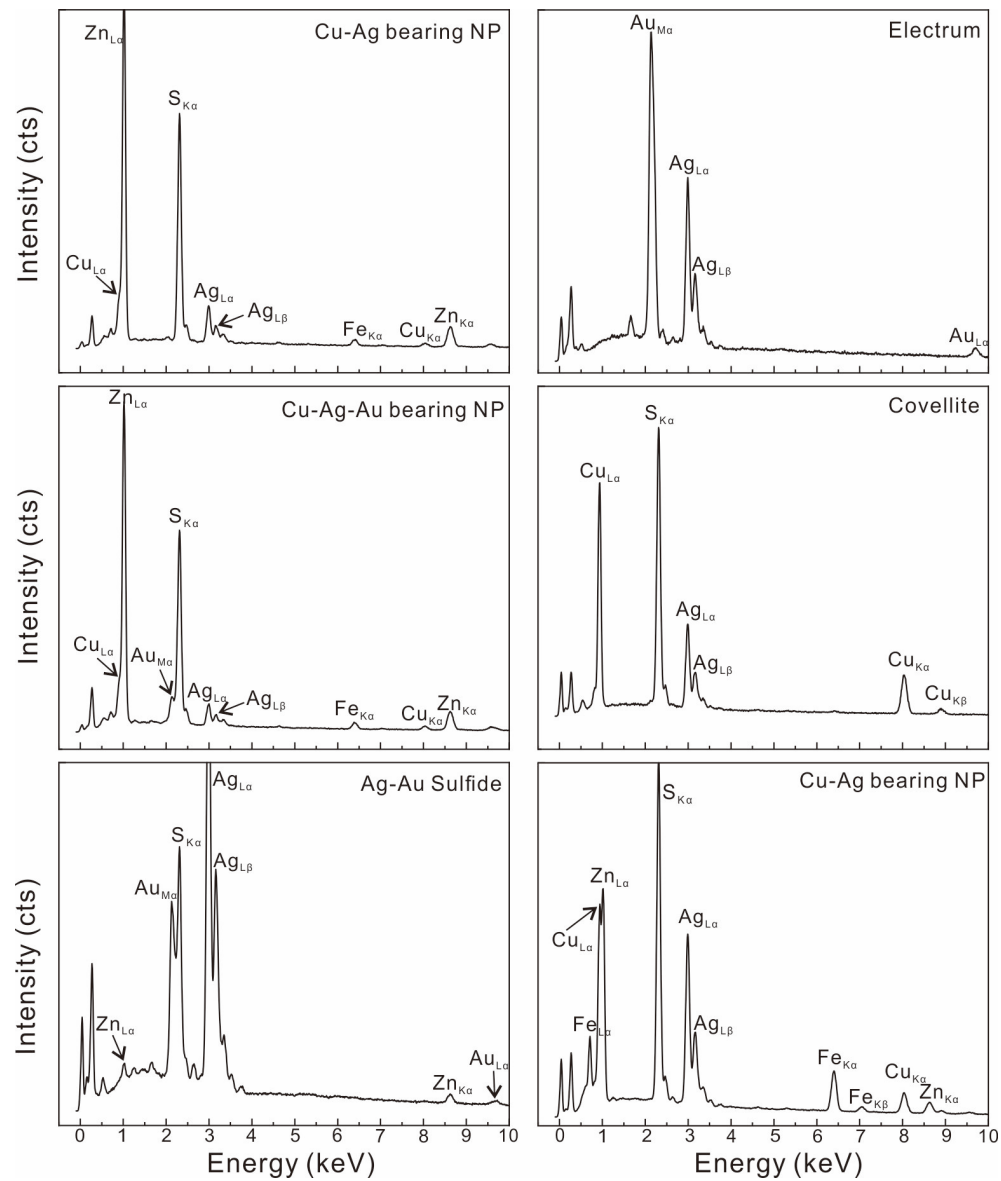


FIGURE S2. Representative EDS spectra for the Ag-(Au)-bearing phases shown in the BSE images.

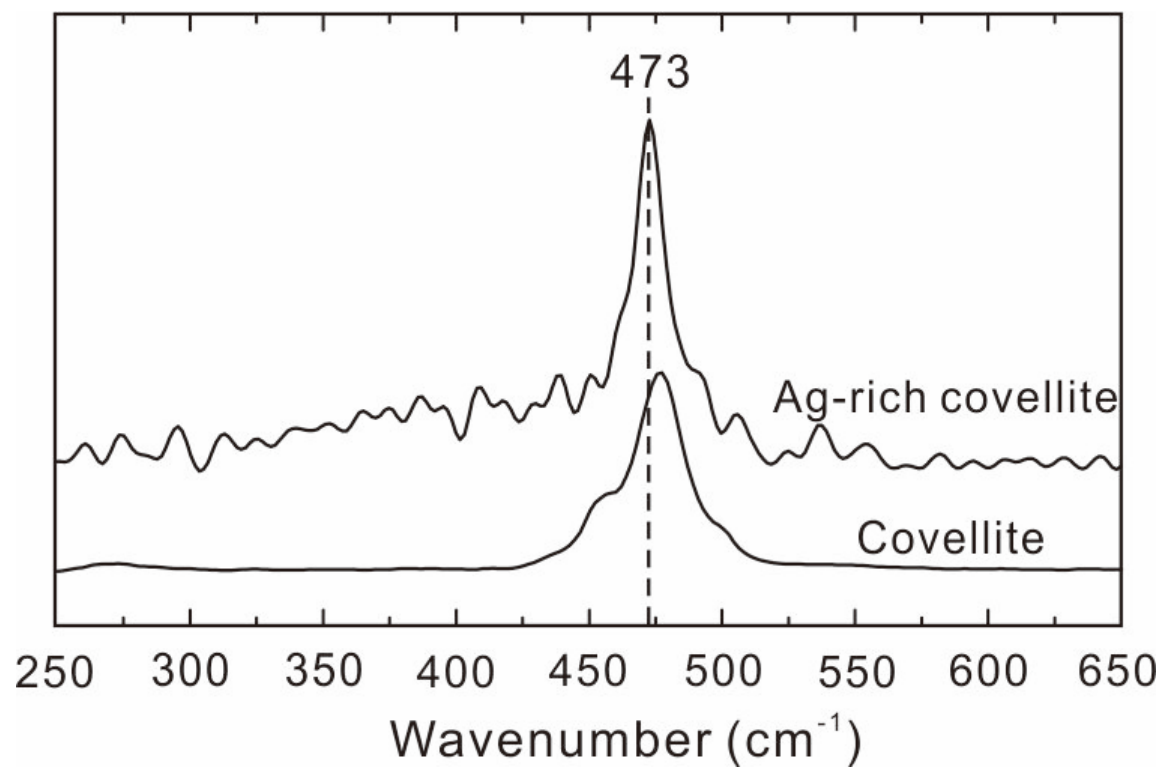


FIGURE S3. Representative room-temperature Raman spectrum of natural Ag-rich covellite from the Maluntou deposit. Standard covellite is collected from the RRUFF database (<http://rruff.info/>). Selected wavenumber range is from 250 and 650 cm⁻¹.

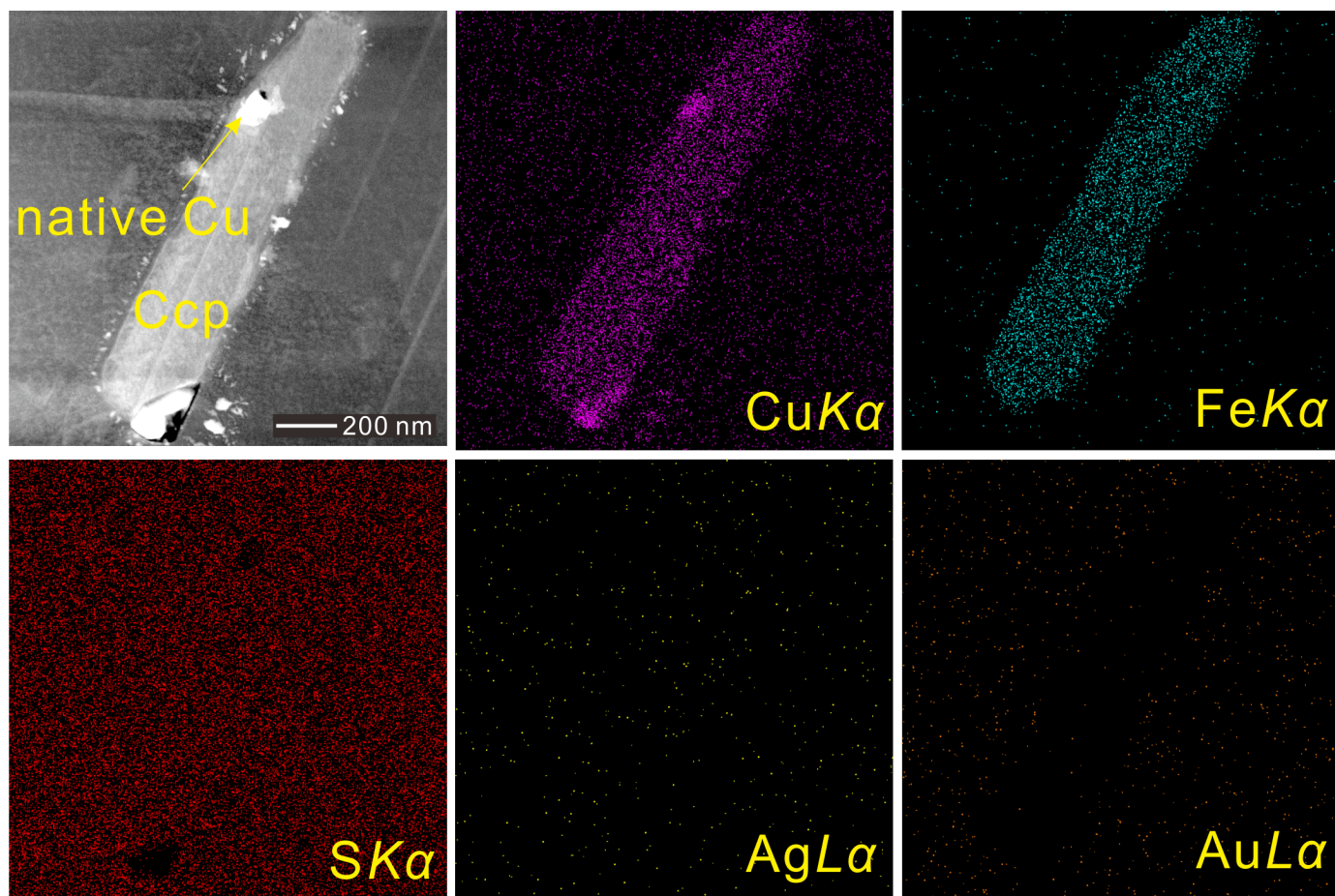


FIGURE S4. STEM and EDS maps showing the distribution of native Cu. The Cu signal is partially from the TEM grid.

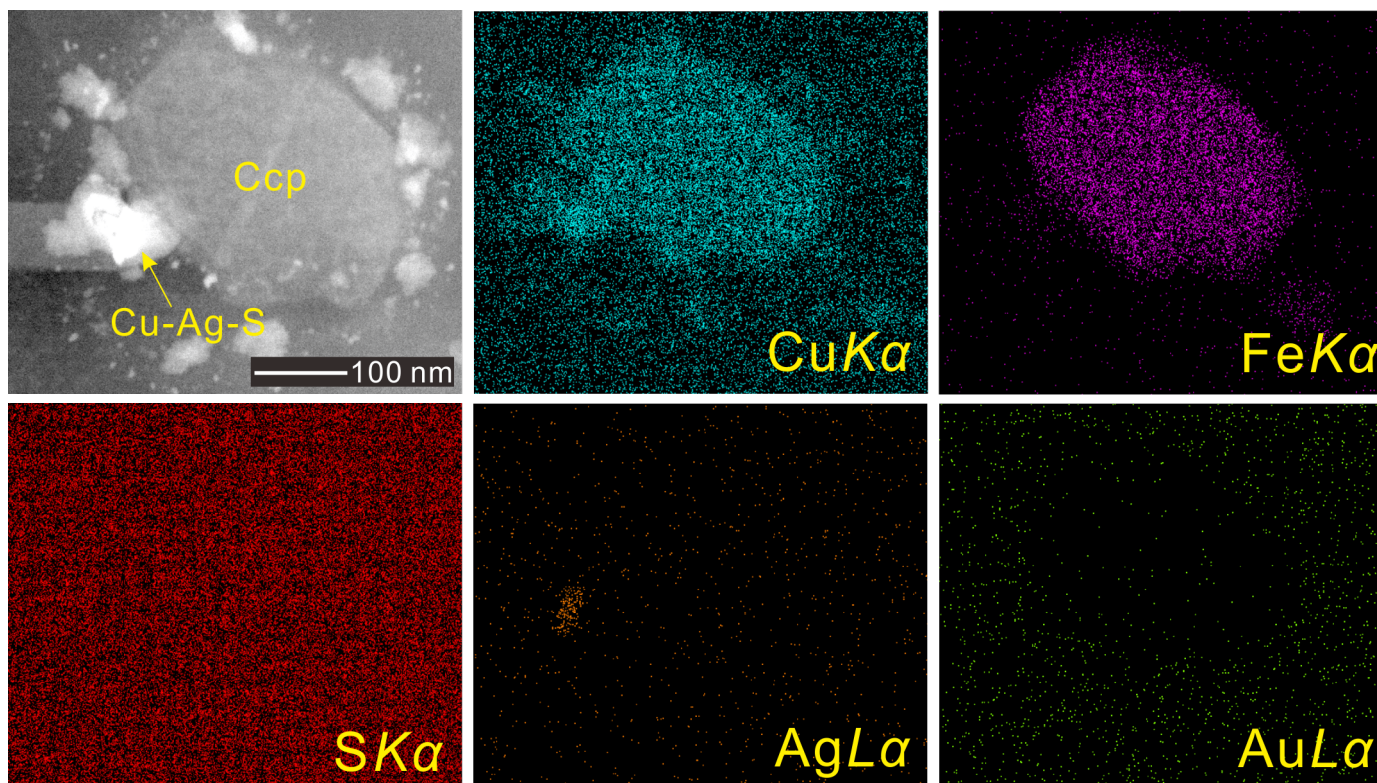


FIGURE S5. STEM and EDS maps showing the distribution of Cu-Ag-S nanoparticle. The Cu signal is partially from the TEM grid.

Table S1. Representative EMPA data (in wt%) of sphalerites from the Maluntou deposit.

No	Fe (0.03)	Cu (0.05)	Zn (0.06)	Pb (0.05)	S (0.01)	As (0.02)	Au (0.02)	Sb (0.01)	Ni (0.02)	Ag (0.006)	Mn (0.01)	Total
1	1.29	1.33	62.88	0	32.79	b.l.	b.l.	0.02	b.l.	b.l.	0.22	99.11
2	2.38	1.82	62.55	0.22	32.57	b.l.	b.l.	b.l.	0.02	b.l.	0.19	99.30
3	1.82	1.64	62.74	0.14	32.40	b.l.	0.02	b.l.	b.l.	b.l.	0.23	98.28
4	0.13	b.l.	65.81	b.l.	32.68	b.l.	b.l.	0.02	b.l.	b.l.	0.01	99.57
5	0.18	b.l.	66.13	0.09	32.47	b.l.	b.l.	b.l.	b.l.	b.l.	0.02	98.29
6	0.22	0.09	66.47	b.l.	32.20	b.l.	b.l.	b.l.	b.l.	b.l.	0.02	98.97
7	0.14	0.06	66.41	b.l.	32.03	b.l.	b.l.	b.l.	b.l.	b.l.	0.05	98.35
8	0.18	0.03	65.94	b.l.	32.29	0.03	b.l.	b.l.	b.l.	b.l.	0.03	99.15

Note: b.l. = below detection limit; Detection limits are presented below each element label.