

Table S1 The elemental compositions (%) of the marmatite and bornite

minerals	Fe	Zn	S	O	Si	Pb	Cu	Al
marmatite	14.671	48.282	33.781	2.223	0.581	0.014	0.002	0.061
bornite	9.982	0.016	24.222	2.528	0.555	0.197	62.301	0.119
minerals	Cd	Bi	Mn	In	As	Ca		
marmatite	0.008	0.022	0.101	0.045	0.207	/		
bornite	/	/	/	/	/	0.053		

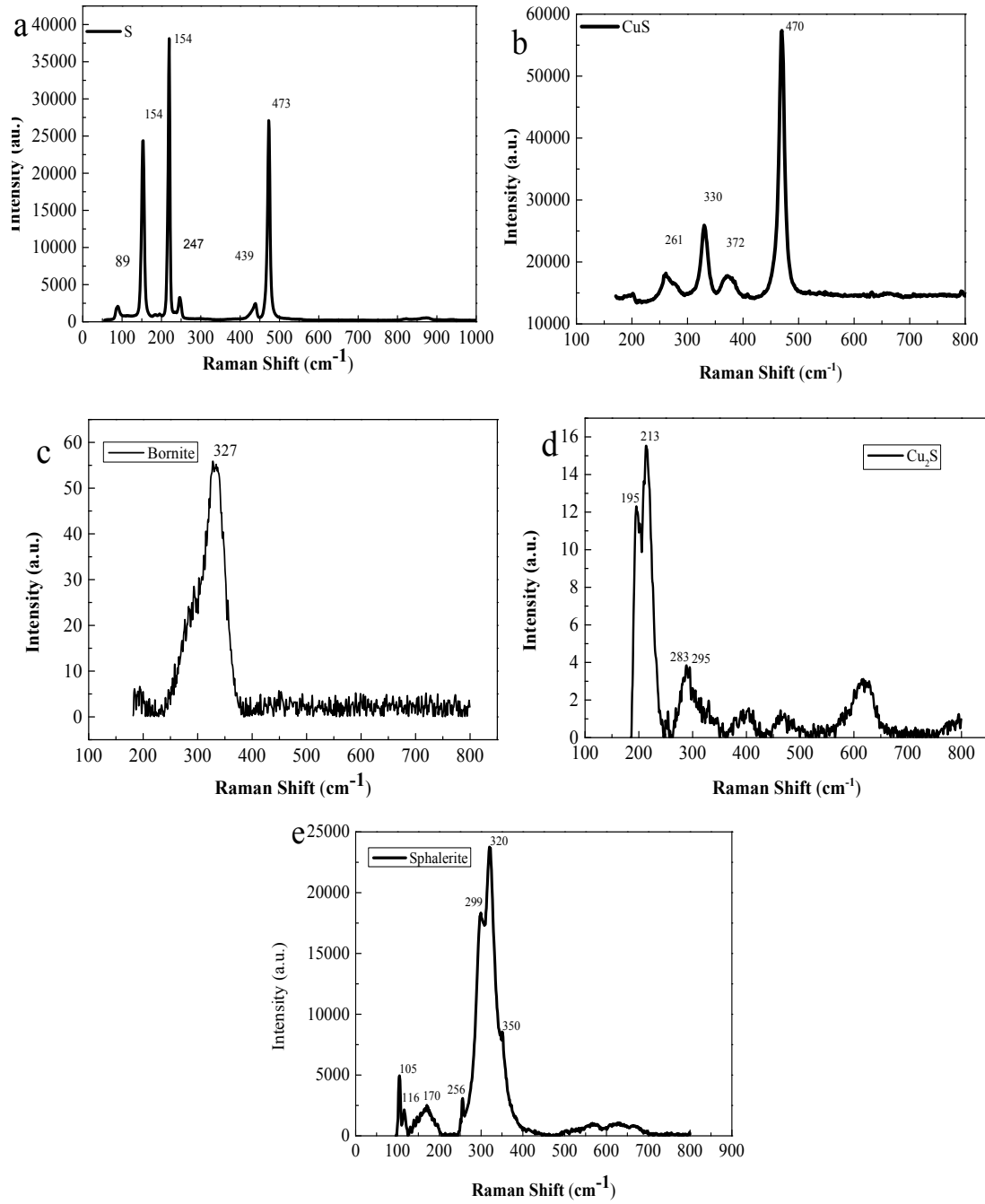


Fig. S1 Standard Raman spectrum peak: (a) S, (b) CuS, (c) Bornite ($\text{Cu}_5\text{FeS}_4\text{S}$), (d) Cu_2S , (e) Sphalerite