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SupplementaryMaterials

Metal Sources of World-Class Polymetallic W–Sn Skarns in the Nanling Range, South China: Granites versus Sedimentary Rocks?

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Table S1. Major element compositions of skarns from the Huangshaping, Shizhuyuan and Xianghualing deposit (%).

Data Source	Samples No.	SiO_2	Al_2O_3	FeO^T	MgO	CaO	Na_2O	K_2O	MnO	TiO_2	P_2O_5	LOI
Huangshaping												
This study	7.11-14	74.87	12.48	0.98	0.28	1.33	3.95	4.82	0.07	0.02	0.01	1.05
	7.11-3	74.37	11.92	1.02	0.39	1.67	1.29	6.88	0.08	0.07	0.01	2.12
	7.14-21	34.50	10.13	13.28	0.74	37.78	0.11	0.73	1.16	0.11	0.05	1.34
	7.8-4	37.18	1.98	23.09	1.16	34.29	0.03	0.12	1.61	0.02	0.02	0.44
	9.23-18	49.83	8.68	5.10	20.07	6.07	0.13	6.25	0.15	0.11	0.03	2.99
Qi et al. [31]	HSP3-6	43.94	4.08	20.22	1.23	25.58	0.52	1.10	0.66	0.17	0.02	5.45
	HSP3-7	76.20	1.00	5.30	0.20	12.32	0.19	0.39	0.27	<0.004	0.02	4.79
	HSP3-11	39.40	2.54	26.44	1.43	24.61	0.21	1.10	0.53	0.01	0.02	7.64
	HSP3-13	28.77	2.60	34.84	3.71	25.43	0.17	0.68	0.93	0.05	0.02	9.35
	HSP3-15	53.50	2.49	22.79	1.34	15.86	0.10	1.10	0.34	0.04	0.01	9.06
	HSP3-16	64.64	1.10	17.16	0.50	12.21	0.05	0.20	0.40	<0.004	0.01	7.08
	HSP3-19	32.40	2.96	46.25	1.45	18.03	0.07	1.26	0.80	0.01	0.01	7.92
	HSP3-21	81.37	1.09	9.77	0.58	3.87	0.08	0.16	0.38	0.03	0.02	5.71
	HSP3-23	87.18	0.56	1.33	0.09	6.02	0.08	0.12	0.15	0.04	0.02	3.45
Shizhuyuan												
This study	SZY8-4	39.21	7.64	12.48	2.33	31.10	0.53	0.07	2.25	0.27	0.12	2.69
	SZY8-8	33.77	13.98	9.48	0.43	31.80	0.19	0.28	2.46	1.06	0.09	2.23
	SZY8-9	46.26	9.97	15.48	0.17	15.60	2.55	1.23	0.43	0.02	<0.01	3.43
	SZY8-10	36.11	5.85	14.73	0.37	31.90	0.37	0.15	1.30	0.02	0.01	5.18
	SZY8-11	33.19	13.04	21.61	0.84	10.40	0.49	3.73	0.12	0.18	0.02	12.38
Cheng [25]	385-3	17.03	3.08	1.58	1.13	43.62	0.14	0.20	0.48	0.20	0.03	32.42
	385-4	29.96	9.57	5.72	2.28	33.84	0.15	0.04	0.84	0.37	0.06	17.12
	420-4	20.58	5.69	14.17	0.49	40.37	0.35	0.17	0.81	0.01	0.01	17.18
	432-5	24.45	6.86	7.47	5.57	35.43	0.67	0.42	0.64	0.14	0.03	18.22
	457-1	21.63	12.27	5.91	0.71	35.83	1.09	2.26	0.37	0.02	0.02	19.44
Xianghualing												
This study	XHL5-9	53.47	2.89	8.47	16.10	16.30	0.21	0.70	0.42	0.12	0.07	1.82
	XHL5-15	28.04	9.98	8.87	2.53	36.60	0.22	0.93	0.68	0.04	0.03	6.32
	XHL6-4	26.83	19.82	15.19	12.20	9.13	0.49	1.24	0.12	0.97	0.20	9.58
	XHL6-9	33.92	21.06	13.72	11.25	2.27	0.28	4.87	0.18	1.11	0.20	6.12
	XHL6-10	33.38	16.86	6.67	2.74	31.50	0.04	1.46	0.35	0.01	0.01	5.62
	XHL6-12	27.94	11.12	7.21	12.30	20.90	0.07	4.90	0.49	<0.01	<0.01	6.12

Table S2. Trace element compositions of skarns in the Huangshaping deposit (ppm).

Samples No.	7.11-14	7.11-3	7.14-21	7.8-4	9.23-18	HSP3-6	HSP3-7	HSP3-11	HSP3-13	HSP3-15	HSP3-16	HSP3-19	HSP3-21	HSP3-23
Data Source			**This Study**							**Qi et al. [31]**				
Ba	3.8	28.2	5.1	0.8	309	4.11	2.11	4.04	10.1	4.25	4.65	6.62	8.66	2.53
Rb	806	598	95.3	18.9	1640	248	70.9	607	390	786	88.3	654	69.6	22.6
Cr	<10	<10	<10	10	10									
Cs	24.2	9.14	2.31	1.42	120.5	4.43	0.123	14.1	10	19.5	2.21	18.3	0.464	0.041
Sr	9.9	41.9	11.4	6.8	26.9	16.9	10.5	13.6	99.6	15.2	18	13.1	22.7	18.3
Nb	88.2	41.4	25.1	3.9	20.9	28.2	0.304	5.23	4.2	6.76	0.885	8.61	0.459	0.864
V	<5	<5	<5	7	16									
Ga	27.8	21.3	17.6	7.4	15.9									
Ta	15.3	4.3	2.2	0.2	2.3	4.34	0.042	0.181	0.117	3.32	0.015	0.344	0.995	0.371
La	17.2	32.1	1.7	1	4.9	21.1	28	22.2	9.68	12	8.87	12.7	14.4	38.5
Ce	45.3	72.6	4.5	4.6	12.6	53.9	74.7	53.6	21.2	27.3	23	35.2	34.9	95.4
Pr	6.19	8.85	0.8	0.93	1.73	6.98	10.8	6.29	2.41	3.43	2.96	45.8	4.06	13
Nd	24.7	32.2	5.3	5.8	7.3	24.9	40.6	17.1	6.97	10	9.66	12.2	11.5	50.4
Sm	10.1	8.09	3.26	2.87	2.65	6.17	14.2	3.25	1.44	2.79	2.91	2.58	2.62	16.8
Eu	<0.03	0.1	0.12	0.06	0.09	0.098	0.039	0.068	0.069	0.024	0.013	0.017	0.011	0.018
Gd	13.55	8.01	4.66	3.32	3.27	4.02	12.3	1.84	0.794	1.61	1.69	1.33	1.69	16.9
Tb	2.71	1.34	0.82	0.49	0.63	0.828	3.09	0.363	0.164	0.44	0.426	0.264	0.369	3.93
Dy	17.35	8.1	4.93	2.47	3.96	4.64	19.9	2	0.950	2.83	2.62	1.58	2.12	24.5
Ho	3.73	1.66	1.04	0.45	0.9	0.707	3.53	0.304	0.142	0.398	0.382	0.247	0.358	4.29
Er	11.75	4.97	3.1	1.2	2.63	2.24	11.7	0.974	0.461	1.34	1.3	0.773	1.12	14.5
Tm	1.91	0.76	0.49	0.17	0.39	0.433	2.29	0.197	0.081	0.293	0.272	0.178	0.225	2.59
Yb	13.25	5.12	3.27	1.05	2.35	3.25	16.4	1.62	0.69	2.45	2.13	1.52	1.79	18.5
Lu	1.97	0.75	0.48	0.15	0.3	0.475	2.49	0.239	0.088	0.368	0.327	0.225	0.27	2.75
Y	117.5	48.2	31.3	12.4	23.9	15.5	85.3	5	3.07	5.51	4.94	4.46	7.26	148
Hf	8.2	6.1	3.5	0.2	3.1	28.3	14.3	20.3	19.1	20	7.6	14.4	13.3	17.8
Zr	100	130	90	<20	70	58.5	6.15	8.68	20.2	13.6	2.1	12.5	2.82	2.44
U	32	14.9	0.97	3.05	8.38	6.25	3.65	5.81	3.81	4.15	1.73	3.04	5.38	5.2
Th	48	43.8	1.06	4.42	13.7	6.62	5.65	3.92	1.61	1.67	0.816	1.74	2.99	5.45
W	21	9	98	1560	12									
Sn	14	25	2250	864	18									
Ba/Rb	0.005	0.05	0.05	0.04	0.19	0.02	0.03	0.01	0.03	0.01	0.05	0.01	0.12	0.11
Ba/Sr	0.38	0.67	0.45	0.12	11.49	0.24	0.20	0.30	0.10	0.28	0.26	0.51	0.38	0.14
ΣREE	169.7	184.7	34.5	24.6	43.7	129.7	240.0	110.0	45.1	65.3	56.6	114.6	75.4	302.1
ΣLREE	103.5	153.9	15.7	15.3	29.3	113.1	168.3	102.5	41.8	55.5	47.4	108.5	67.5	214.1
ΣHREE	66.2	30.7	18.8	9.3	14.4	16.6	71.7	7.5	3.4	9.7	9.1	6.1	7.9	88.0
$(LREE/HREE)_T$	1.56	5.01	0.83	1.64	2.03	6.82	2.35	13.60	12.39	5.71	5.18	17.74	8.50	2.43

$(La/Yb)_N$	0.93	4.50	0.37	0.68	1.50	4.66	1.22	9.83	10.06	3.51	2.99	5.99	5.77	1.49
Eu/Eu*	1.00	0.04	0.09	0.06	0.09	0.06	0.01	0.08	0.18	0.03	0.02	0.03	0.01	0.00
Ce/Ce*	1.07	1.04	0.94	1.07	1.06	1.08	1.05	1.10	1.05	1.03	1.10	0.21	1.10	1.04

Table S3. Trace element compositions of skarns in the Shizhuyuan deposit (ppm).

Samples No.:	**SZY8-4**	**SZY8-8**	**SZY8-9**	**SZY8-10**	**SZY8-11**	**385-3**	**385-4**	**420-4**	**432-5**	**457-1**
Data source			**This study**					**Cheng [25]**		
Ba	1.7	4	14.1	1.1	86.2	50.5	6.55	2.95	6.11	26
Rb	8.6	84.1	379	70.5	1245	44.4	1.32	73.4	34.7	733
Cr	30	100	<10	<10	20	12.5	31.7	1.79	14.7	2.38
Cs	1.98	3.44	12.25	3.37	38.4	3.84	0.774	2.89	0.633	44.1
Sr	52.6	20.4	54.8	26.1	680	344	79.9	45	60.2	70.1
Nb	5	40	12.9	2.3	10.6	5.01	7.41	12.1	10.3	17.7
V	37	52	12	23	28	19.5	43.6	4.92	23.1	5.76
Ga	15.7	29.8	36.9	24.4	60.3	7.42	18.1	23.6	23	31.6
Ta	0.5	9	4.2	0.3	0.9					
La	25.9	14	15.7	8.3	10.9	14.8	32.7	25.2	28.2	33.8
Ce	48.5	30.9	48.5	18.5	26.8	29.5	62.3	57.1	64.1	80.5
Pr	4.86	3.36	6.5	1.86	3.08	3.15	6.66	7.15	7.01	10.6
Nd	16.6	11.5	20.6	4.7	10.4	11.3	22.9	23.9	18.6	36.7
Sm	3.41	2.84	4.92	1.21	3.02	22.2	4.25	8.29	3.73	12.2
Eu	0.54	0.32	0.18	0.11	0.14	0.406	0.737	0.094	0.28	0.09
Gd	3.13	2.84	2.86	0.65	2.22	1.91	3.67	6.22	2.46	9.69
Tb	0.52	0.55	0.59	0.15	0.47	0.278	0.567	1.48	0.397	2.34
Dy	3.04	3.78	3.41	0.75	3.02	1.45	3.19	8.65	2.01	15
Ho	0.61	0.85	0.63	0.13	0.56	0.301	0.622	1.57	0.365	2.83
Er	1.69	2.81	1.86	0.39	1.83	0.929	1.75	4.72	1.17	8.68
Tm	0.25	0.51	0.32	0.08	0.4	0.131	0.28	0.916	0.2	1.63
Yb	1.56	3.96	2.38	0.58	3.03	0.872	1.68	6.48	1.48	12.8
Lu	0.23	0.64	0.36	0.09	0.52	0.13	0.237	0.864	0.209	1.73
Y	17.4	19.3	13.9	1.6	15.1	8.93	17.3	32.3	9.06	47
Hf	3	11	1.3	0.2	1.3	1.81	2.53	0.329	1.32	0.507
Zr	107	365	15	6	46	67.7	108	5.75	53.3	8.42
U	1.95	4.96	9.4	4.94	36.7	1.72	4.53	14.5	20.7	25.6
Th	8.5	15.65	9.55	1.27	11.95	3.99	7.55	4.89	4.83	9.53
W	644	13700	1655	1535	355	117	1770	231	375	4810
Sn	618	1530	4420	2320	540					
Ba/Rb	67.57	27.64	26.94	17.66	24.87	37.58	220.12	19.68	99.76	25.62

Ba/Sr	0.16	4.12	6.92	2.70	1.83	0.13	0.02	1.63	0.58	10.46
ΣREE	110.8	78.9	108.8	37.5	66.4	87.4	141.5	152.6	130.2	228.6
ΣLREE	99.8	62.9	96.4	34.7	54.3	81.4	129.5	121.7	121.9	173.9
ΣHREE	11.0	15.9	12.4	2.8	12.1	6.0	12.0	30.9	8.3	54.7
$(LREE/HREE)_T$	9.05	3.95	7.77	12.30	4.51	13.56	10.80	3.94	14.71	3.18
$(La/Yb)_N$	11.91	2.54	4.73	10.26	2.58	12.17	13.96	2.79	13.67	1.89
Eu/Eu*	0.50	0.34	0.13	0.34	0.16	0.09	0.56	0.04	0.27	0.02
Ce/Ce*	0.99	1.07	1.18	1.11	1.12	1.01	0.98	1.03	1.09	1.03

Table S4. Trace element compositions of skarns in the Xianghualing deposit (ppm).

Samples No.	XHL5-9	XHL5-15	XHL6-4	XHL6-9	XHL6-10	XHL6-12
Ba	368	10.1	118.5	1045	29.9	16.5
Rb	139.5	452	321	1310	591	2440
Cr	20	10	100	110	10	<10
Cs	14.75	132	74.9	267	43.9	610
Sr	20.1	28.2	154	64.6	95.6	26.9
Nb	2.6	48.9	21.4	22.7	56.7	0.9
V	20	<5	125	123	<5	<5
Ga	7.8	26.6	31.2	31.5	24.4	6.2
Ta	0.3	16.1	1.9	2	45.5	0.9
La	14.4	104	45.6	75.4	17.9	1.8
Ce	27.8	245	89.8	153.5	49.8	3.5
Pr	3.64	26.9	9.55	16	6.03	0.36
Nd	13.7	81	34.7	55.7	19.2	1.2
Sm	3.38	26.8	7.27	9.96	6.78	0.22
Eu	0.6	0.43	1.39	1.98	0.51	0.21
Gd	3.98	25.3	7.07	7.09	5.92	0.2
Tb	0.64	6.83	1.22	0.97	1.41	0.04
Dy	3.94	50.6	7.57	5.36	9.67	0.16
Ho	0.79	11.2	1.63	1.04	1.85	0.03
Er	2.22	38.7	4.66	2.93	6.26	0.11
Tm	0.31	7.59	0.72	0.46	1.12	0.02
Yb	1.73	60.2	4.61	3.12	8.62	0.13
Lu	0.28	8.9	0.75	0.52	1.25	0.02
Y	24.4	207	45	25.4	32	1.1
Hf	1.4	2.7	9.5	14.1	5.9	<0.2
Zr	50	34	345	534	42	2
U	2.67	90.3	4.16	5.92	28.6	0.22
Th	3.6	18.25	20.1	26	22.7	0.19
W	2	1950	90	37	9	11
Sn	547	1640	124	>10,000	470	86
Ba/Rb	41.66	17.08	32.07	30.86	20.51	16.67
Ba/Sr	6.94	16.03	2.08	20.28	6.18	90.71
ΣREE	77.4	693.5	216.5	334.0	136.3	8.0
ΣLREE	63.5	484.1	188.3	312.5	100.2	7.3
ΣHREE	13.9	209.3	28.2	21.5	36.1	0.7
$(LREE/HREE)_T$	4.57	2.31	6.67	14.54	2.78	10.27
$(La/Yb)_N$	5.97	1.24	7.10	17.33	1.49	9.93
Eu/Eu*	0.50	0.05	0.59	0.69	0.24	3.00
Ce/Ce*	0.92	1.11	1.00	1.03	1.17	1.00

Table S5. Minimum, maximum and average values of trace element compositions in skarns, granites and strata (ppm).

	Rock type	Source	Ba	Rb	Cr	Cs	Sr	Nb	V	Ga	Ta	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er
Minimum		HSP	0.8	18.9	<10	0.0	6.8	0.3	<5	7.4	0.0	1.0	4.5	0.8	5.3	1.4	0.01	0.8	0.2	0.9	0.1	0.5
	Skarn	SZY	1.1	1.3	1.8	0.6	20.4	2.3	4.9	7.4	0.3	8.3	18.5	1.9	4.7	1.2	0.09	0.7	0.2	0.8	0.1	0.4
		XHL	10.1	139.5	10.0	14.8	20.1	0.9	20.0	6.2	0.3	1.8	3.5	0.4	1.2	0.2	0.21	0.2	0.0	0.2	0.0	0.1
		HSP	1.3	667.0	<10	4.5	3.9	58.9	<5	22.2	8.5	5.1	14.6	2.6	14.2	6.9	0.02	9.5	2.0	13.2	2.9	8.8
	Granite	SZY	1.5	742.0	0.1		4.7	15.5	0.2	28.5	11.9	15.4	41.7	5.9	24.4	10.2	0.03	11.0	2.3	15.2	2.9	9.5
		XHL	2.5	759.0	10.0	13.4	6.5	45.3	<5	23.0	17.2	39.3	92.9	10.5	33.4	9.2	0.03	8.4	1.9	13.3	2.8	9.0
	Strata		1.7	0.6		0.2	109.0	0.1			0.0	0.7	1.4	0.2	0.5	0.1	0.02	0.1	0.0	0.1	0.0	0.1
	Rock type	**Source**	**Ba**	**Rb**	**Cr**	**Cs**	**Sr**	**Nb**	**V**	**Ga**	**Ta**	**La**	**Ce**	**Pr**	**Nd**	**Sm**	**Eu**	**Gd**	**Tb**	**Dy**	**Ho**	**Er**
Maximum		HSP	309.0	1640.0	10.0	120.5	99.6	88.2	16.0	27.8	15.3	38.5	95.4	45.8	50.4	16.8	0.12	16.9	3.9	24.5	4.3	14.5
	Skarn	SZY	86.2	1245.0	100.0	44.1	680.0	40.0	52.0	60.3	9.0	33.8	80.5	10.6	36.7	22.2	0.74	9.7	2.3	15.0	2.8	8.7
		XHL	1045.0	2440.0	110.0	610.0	154.0	56.7	125.0	31.5	45.5	104.0	245.0	26.9	81.0	26.8	1.98	25.3	6.8	50.6	11.2	38.7
		HSP	27.2	1390.0	<10	34.8	33.8	95.0	<5	30.9	18.2	21.7	55.6	7.6	31.4	12.6	0.04	15.6	3.1	19.8	4.4	13.3
	Granite	SZY	10.7	1190.0	4.9		25.4	38.3	1.0	39.4	28.4	47.1	150.5	22.4	88.2	40.3	0.03	38.5	8.8	55.0	10.8	33.2
		XHL	132.5	2520.0	10.0	170.5	70.2	88.2	<5	34.6	50.0	82.0	146.5	23.1	82.4	26.4	0.21	28.9	6.0	39.5	8.7	26.8
	Strata		4.6	63.7		2.4	414.0	1.2			0.3	1.8	3.4	0.5	1.7	0.3	0.10	0.3	0.1	0.4	0.1	0.3
	Rock type	**Source**	**Ba**	**Rb**	**Cr**	**Cs**	**Sr**	**Nb**	**V**	**Ga**	**Ta**	**La**	**Ce**	**Pr**	**Nd**	**Sm**	**Eu**	**Gd**	**Tb**	**Dy**	**Ho**	**Er**
Average		HSP	28.1	435.3	10.0	16.2	23.2	16.8	11.5	18.0	2.4	16.0	39.9	8.2	18.5	5.7	0.06	5.4	1.1	7.0	1.3	4.1
	Skarn	SZY	19.9	267.4	26.6	11.2	143.3	12.3	24.9	27.1	3.0	21.0	46.7	5.4	17.7	6.6	0.29	3.6	0.7	4.4	0.8	2.6
		XHL	264.7	875.6	50.0	190.4	64.9	25.5	89.3	21.3	11.1	43.2	94.9	10.4	34.3	9.1	0.85	8.3	1.9	12.9	2.8	9.1
		HSP	7.2	973.8	<10	17.9	13.5	86.0	<5	28.6	15.1	17.1	45.0	6.2	25.8	10.6	0.02	13.7	2.7	17.6	3.8	12.0
	Granite	SZY	6.1	969.3	1.4		9.9	25.1	0.5	32.4	17.6	26.7	74.8	10.9	43.9	19.5	0.03	20.4	4.4	28.5	5.6	17.2
		XHL	46.8	1559.0	10.0	79.4	18.3	64.2	<5	29.7	26.2	48.2	108.3	13.0	42.6	13.0	0.08	12.7	2.9	19.6	4.2	13.8
	Strata		3.0	17.5		0.8	197.8	0.5			0.1	1.4	2.7	0.4	1.2	0.2	0.06	0.3	0.0	0.3	0.1	0.2

Table S5. Cont.

	Rock type	Source	Tm	Yb	Lu	Y	Hf	Zr	U	Th	W	Sn	K/Rb	Rb/Sr	ΣREE	ΣLREE	ΣHREE	(LREE/HREE)$_T$	(La/Yb)$_N$	Eu/Eu*
Minimum		HSP	0.1	0.7	0.1	3.1	0.2	2.1	1.0	0.8	9.0	14.0	11.6	0.1	24.6	15.3	3.4	0.8	0.4	<0.01
	Skarn	SZY	0.1	0.6	0.1	1.6	0.2	5.8	1.7	1.3	117.0	540.0	17.7	0.0	37.5	34.7	2.8	3.2	1.9	0.02
		XHL	0.0	0.1	0.0	1.1	1.4	2.0	0.2	0.2	2.0	86.0	16.7	2.1	8.0	7.3	0.7	2.3	1.2	0.05
		HSP	1.4	9.1	1.4	93.7	7.1	90.0	15.3	33.3	10.0	3.0	31.3	28.0	91.7	43.4	48.4	0.9	0.4	<0.01
	Granite	SZY	1.6	12.4	1.9	85.3	2.4	20.0	8.1	8.9	10.5	8.1	26.4	46.3	154.3	97.6	56.7	1.4	0.7	<0.01
		XHL	1.6	11.9	1.8	60.2	3.8	30.0	5.4	15.5	16.0	7.0	8.9	15.8	246.4	185.3	50.6	2.5	1.5	0.01
	Strata		0.0	0.1	0.0	0.6	0.1	1.6	1.0	0.1			52.1	0.0	3.3	2.9	0.4	5.0	5.1	0.48
	Rock type	**Source**	**Tm**	**Yb**	**Lu**	**Y**	**Hf**	**Zr**	**U**	**Th**	**W**	**Sn**	**K/Rb**	**Rb/Sr**	**ΣREE**	**ΣLREE**	**ΣHREE**	**(LREE/HREE)$_T$**	**(La/Yb)$_N$**	**Eu/Eu***
Maximum		HSP	2.6	18.5	2.8	148.0	28.3	130.0	32.0	48.0	1560.0	2250.0	95.5	11.5	302.1	214.1	88.0	17.7	10.1	1.00
	Skarn	SZY	1.6	12.8	1.7	47.0	11.0	365.0	36.7	15.7	13700.0	4420.0	220.1	10.5	228.6	173.9	54.7	14.7	14.0	0.56
		XHL	7.6	60.2	8.9	207.0	14.1	534.0	90.3	26.0	1950.0	1640.0	41.7	90.7	693.5	484.1	209.3	14.5	17.3	3.00
		HSP	2.2	15.3	2.4	139.5	9.0	120.0	34.4	53.5	120.0	65.0	71.3	205.5	204.2	128.8	75.4	1.7	1.0	0.01
	Granite	SZY	6.2	47.8	7.0	238.0	5.8	61.0	26.8	26.2	158.0	40.0	51.2	234.0	555.8	348.5	207.3	1.9	1.2	0.99
		XHL	4.1	26.9	3.9	256.0	8.6	109.0	45.5	41.3	707.0	1440.0	40.1	324.6	505.4	360.6	144.8	4.0	2.6	0.07
	Strata		0.0	0.2	0.0	2.9	3.8	20.2	2.3	0.6			385.4	0.2	9.2	7.7	1.5	8.3	7.7	1.23
	Rock type	**Source**	**Tm**	**Yb**	**Lu**	**Y**	**Hf**	**Zr**	**U**	**Th**	**W**	**Sn**	**K/Rb**	**Rb/Sr**	**ΣREE**	**ΣLREE**	**ΣHREE**	**(LREE/HREE)$_T$**	**(La/Yb)$_N$**	**Eu/Eu***
Average		HSP	0.7	5.2	0.8	36.6	12.6	39.8	7.0	10.1	340.0	634.2	11.6	1.1	114.0	88.3	25.7	6.1	3.8	0.12
	Skarn	SZY	0.5	3.5	0.5	18.2	2.3	78.2	12.5	7.8	2519.2	1885.6	56.7	2.9	114.3	97.7	16.6	8.4	7.7	0.24
		XHL	1.7	13.1	2.0	55.8	6.7	167.8	22.0	15.1	349.8	573.4	26.5	23.7	244.3	192.7	51.6	6.9	7.2	0.84
		HSP	2.0	13.6	2.1	124.1	8.4	106.7	30.1	46.8	33.9	21.7	48.2	115.0	172.1	104.7	67.4	1.5	0.9	0.01
	Granite	SZY	3.0	22.7	3.3	149.4	4.4	37.5	15.1	15.4	51.1	20.7	38.4	120.6	280.9	175.8	105.1	1.7	0.9	0.22
		XHL	2.4	16.9	2.5	110.3	5.5	66.0	27.6	31.2	195.3	293.7	22.0	146.9	300.1	225.1	75.0	3.1	2.1	0.02
	Strata		0.0	0.2	0.0	1.8	1.3	7.3	1.5	0.3	1.7	6.5	152.2	0.1	7.0	6.0	1.0	6.4	6.4	0.70

Note: HSP = Huangshaping, SZY = Shizhuyuan, XHL = Xianghualing. Data sources: Skarn data are from this study and are reference from [25,31]. Strata composition of the Shidengzi Formation Carboniferous limestone are reference from [31], Devonian mudstone and shale are reference from [77], average values of W and Sn from [81]. Granite composition of the Huangshaping granite porphyry are reference from [24], Shizhuyuan equigranular biotite granite are reference from [44,68], and Xianghualing albite granite are reference from [76].

Table S6. Minimum, maximum and average values of major element compositions in skarns, granites and strata (%).

	Rock type	Source	SiO_2	Al_2O_3	$Fe_2O_3^T$	MgO	CaO	Na_2O	K_2O	MnO	TiO_2	P_2O_5	LOI	Total
Minimum	Skarn	HSP	28.77	0.56	0.98	0.09	1.33	0.03	0.12	0.07	0.01	0.01	0.44	95.66
		SZY	17.03	3.08	1.58	0.17	10.40	0.14	0.04	0.12	0.01	0.01	2.23	95.14
		XHL	26.83	2.89	6.67	2.53	2.27	0.04	0.70	0.12	0.01	0.01	1.82	91.05
	Granite	HSP	73.50	12.75	0.52	0.01	0.39	3.53	3.79	0.03	0.01	0.00	0.58	99.20
		SZY	73.29	11.23	0.38	0.17	0.59	0.39	4.92	0.01	0.00	0.01	0.39	99.58
		XHL	70.88	12.67	1.08	0.01	0.29	0.11	1.53	0.02	0.01	0.01	0.93	98.30
	Strata		1.06	0.09	1.23	0.89	31.73	0.05	0.02	0.15	0.04	0.01	38.45	61.94
	Rock type	**Source**	**SiO_2 (%)**	**Al_2O_3**	**$Fe_2O_3^T$**	**MgO**	**CaO**	**Na_2O**	**K_2O**	**MnO**	**TiO_2**	**P_2O_5**	**LOI**	**Total**
Maximum	Skarn	HSP	87.18	12.48	46.25	20.07	37.78	3.95	6.88	1.61	0.17	0.05	9.35	106.73
		SZY	46.26	13.98	21.61	5.57	43.62	2.55	3.73	2.46	1.06	0.12	32.42	99.93
		XHL	53.47	21.06	15.19	16.10	36.60	0.49	4.90	0.68	1.11	0.20	9.58	100.57
	Granite	HSP	76.35	14.90	1.27	0.42	1.07	5.24	5.19	0.08	0.02	0.01	1.49	100.70
		SZY	76.30	13.27	3.38	0.47	4.00	4.25	5.73	0.21	0.02	0.01	2.71	99.89
		XHL	75.37	16.95	6.70	0.98	1.57	3.91	5.36	0.32	0.02	0.07	2.58	100.47
	Strata		4.67	1.51	6.20	19.48	53.86	0.13	0.40	0.42	0.07	0.01	42.33	62.90
	Rock type	**Source**	**SiO_2 (%)**	**Al_2O_3**	**$Fe_2O_3^T$**	**MgO**	**CaO**	**Na_2O**	**K_2O**	**MnO**	**TiO_2**	**P_2O_5**	**LOI**	**Total**
Average	Skarn	HSP	55.58	4.54	16.26	2.37	16.08	0.50	1.78	0.54	0.06	0.02	4.89	99.65
		SZY	30.22	8.80	10.86	1.43	30.99	0.65	0.85	0.97	0.23	0.04	13.03	98.07
		XHL	33.93	13.62	10.02	9.52	19.45	0.22	2.35	0.37	0.45	0.10	5.93	95.88
	Granite	HSP	74.91	13.72	0.83	0.13	0.67	4.14	4.36	0.04	0.01	0.00	1.04	99.89
		SZY	74.91	12.50	1.38	0.29	1.30	2.72	5.30	0.08	0.02	0.01	1.29	99.80
		XHL	73.56	13.82	3.24	0.20	0.76	2.15	3.80	0.15	0.02	0.02	1.74	99.44
	Strata		2.68	0.53	4.37	6.29	46.52	0.11	0.12	0.24	0.06	0.01	40.20	62.42