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Short Communications (Research Advances)

Zircon LA-ICP-MS U-Pb age of the newly identified Majiawan mafic-ultramafic intrusion in the Hannan complex: Implications for the Cu-Ni mineralization in the northwest Yangtze craton

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1. Objective

At the northwestern corner of the Yangtze Craton, the Hannan area is one of the most important mafic-ultramafic intrusion concentrated districts. Numerous Neoproterozoic intrusions include the Wangjiangshan (819 ± 10 Ma), Bijigou (782 ± 14 Ma), Beiba (880–824 Ma), and Dahanshan (790–780 Ma) plutons intruded in the Houhe, Huodiya and Xixiang groups in the Hannan region. These intrusions are considered as probes to understanding the tectonic evolution of the Yangtze Craton (Zhou MF et al., 2002), but their Cu-Ni mineralization prospecting are unclear. The Majiawan mafic-ultramafic intrusion is a newly identified Cu-Ni sulfide mineralized intrusion in the northwest Hannan Complex, which hosts 15223 t Cu and 7616 t Ni with grades of 0.20%–1.42% and 0.20%–0.72%, respectively. The intrusion is dike-shaped with less than 0.01 km² on the surface and comprised of gabbro, plagioclase-bearing clinopyroxenite, hornblende clinopyroxenite, and hornblende peridotite. The Cu-Ni sulfide mineralization dominantly occurs in hornblende clinopyroxenite and subordinately occurs in the gabbro. This study performed LA-ICP-MS zircon U-Pb dating on the mineralized gabbro in Majiawan intrusion, in order to obtain a precise and accurate crystallization age for the Majiawan Cu-Ni sulfide deposit and to further evaluate the Cu-Ni mineralization potential in Hannan area.

2. Methods

Zircon grains for U-Pb geochronology from the

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mineralized gabbro of the Majiawan Cu-Ni sulfide deposit at 32°49'5.80"N and 106°52'50.93"E were separated using conventional magnetic and density techniques. These zircon grains were mounted in epoxy resin and polished to expose the centers of the grains. The cathodoluminescence (CL) imaging and the LA-ICP-MS zircon U-Pb dating were undertaken at Beijing GeoAnalysis Co., Ltd., Beijing, China. Zircon U-Pb analyses were performed on an Agilent 7700x ICP-MS with a 193 nm Coherent Ar-F gas laser. The measured Pb isotopic compositions were corrected for common Pb by using non-radiogenic ²⁰⁴Pb. Uncertainties on individual analyses are reported at 1σ level, and the mean ages for pooled U/Pb (and Pb/Pb) analyses are quoted with 95% confidence interval. Data reduction was carried out using the Isoplot program (Ludwig KR, 2003).

3. Results

Zircon grains from gabbro sample are euhedral to subhedral and 100–200 μm in length with aspect ratios of 1 : 1 to 3 : 1. Most zircon grains display light to dark luminescence, with faint or no obvious zoning in the CL images (Fig. 1a). U and Th contents vary from 150 × 10⁻⁶ to 675 × 10⁻⁶ and 10 × 10⁻⁶ to 586 × 10⁻⁶, respectively, and Th/U ratios vary from 0.04 to 1.18 (Table 1). These characteristics indicate that the zircon grains are consistent with a mafic igneous origin. Fifteen zircon grains yield concordant ²⁰⁶Pb/²³⁸U ages, ranging from 784 ± 8 Ma to 836 ± 9 Ma with a weighted mean age of 809.7 ± 7.6 Ma (MSWD = 2.9) (Fig. 1b), which is interpreted as the Majiawan mafic-ultramafic intrusion's crystallization age.

4. Conclusion

The Majiawan mafic-ultramafic intrusion is a newly

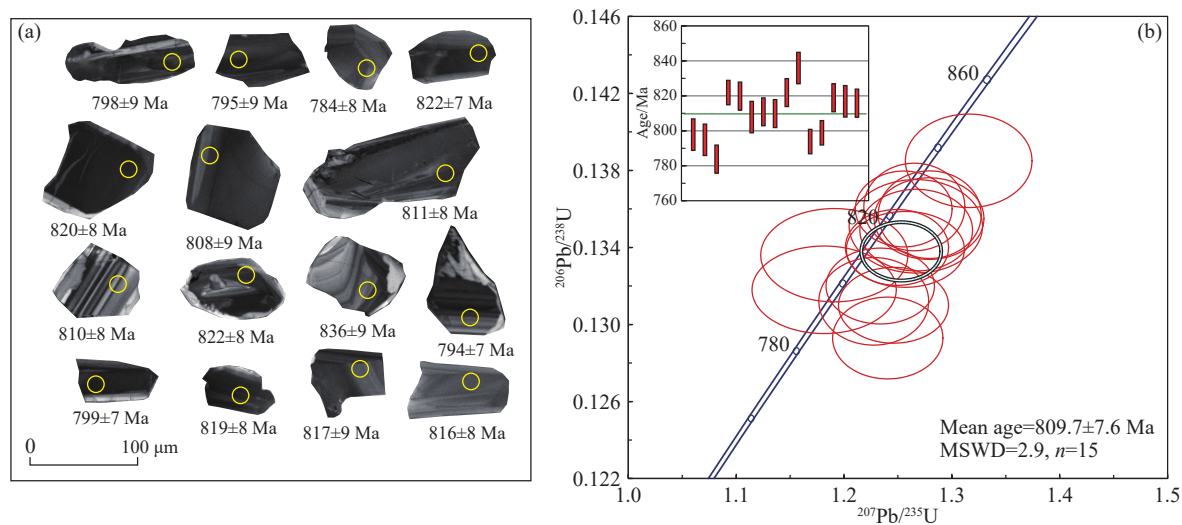


Fig. 1. a–Cathodoluminescence images of zircons; b–zircon U-Pb concordia diagram for the Majiawan mineralized gabbro.

Table 1. LA-ICP-MS zircon U-Pb dating results of the gabbro from Majiawan Cu-Ni sulfide deposit.

Sample	U 10 ⁻⁶	Th	Th/U	Isotope ratio				Age/Ma							
				²⁰⁷ Pb/ ²⁰⁶ Pb	1σ	²⁰⁷ Pb/ ²³⁵ U	1σ	²⁰⁶ Pb/ ²³⁸ U	1σ	²⁰⁷ Pb/ ²⁰⁶ Pb	1σ	²⁰⁷ Pb/ ²³⁵ U	1σ	²⁰⁶ Pb/ ²³⁸ U	1σ
M-01	159	185	1.17	0.0649	0.0024	1.1816	0.0442	0.1318	0.0015	772	81	792	21	798	9
M-02	452	103	0.23	0.0675	0.0017	1.2276	0.0336	0.1312	0.0015	854	54	813	15	795	9
M-03	604	532	0.88	0.0692	0.0018	1.2406	0.0338	0.1293	0.0014	906	56	819	15	784	8
M-04	675	183	0.27	0.0668	0.0016	1.2553	0.0296	0.136	0.0013	831	48	826	13	822	7
M-05	499	586	1.18	0.0684	0.0017	1.2795	0.0315	0.1357	0.0015	880	52	837	14	820	8
M-06	150	177	1.18	0.0649	0.0025	1.191	0.045	0.1336	0.0016	772	82	796	21	808	9
M-07	457	172	0.38	0.0675	0.0017	1.2491	0.0316	0.134	0.0013	854	-147	823	14	811	8
M-08	267	10	0.04	0.0678	0.0019	1.2569	0.0361	0.1339	0.0013	862	56	827	16	810	8
M-09	659	55	0.08	0.0672	0.0015	1.2652	0.0309	0.1361	0.0015	843	52	830	14	822	8
M-10	320	127	0.40	0.0689	0.002	1.3156	0.0388	0.1385	0.0016	898	66	853	17	836	9
M-11	379	141	0.37	0.0688	0.0018	1.2459	0.0337	0.131	0.0013	892	54	822	15	794	7
M-12	364	412	1.13	0.0678	0.0018	1.2336	0.0332	0.132	0.0013	865	57	816	15	799	7
M-13	469	458	0.97	0.0682	0.0017	1.2788	0.0336	0.1355	0.0014	876	45	836	15	819	8
M-14	212	78	0.37	0.0679	0.0022	1.2666	0.0408	0.1351	0.0016	866	67	831	18	817	9
M-15	528	504	0.95	0.0681	0.0019	1.2669	0.0345	0.1349	0.0014	870	57	831	15	816	8

identified Cu-Ni mineralized intrusion in the Hannan Complex, northwest Yangtze Craton. The mineralized gabbro in the intrusion was dated to be 809.7±7.6 Ma using the LA-ICP-MS zircon U-Pb dating, which is similar to the Wangjiangshan Cu-Ni mineralized intrusion (819±10 Ma) at Neoproterozoic (Zhou MF et al., 2002; Lü LS et al., 2018). These two synchronous mineralized mafic-ultramafic intrusions indicated that the Hannan area is an essential prospecting target for Cu-Ni sulfide mineralization.

CRediT authorship contribution statement

Guo-chao Zhou and Hong-jing Xie conceived of the presented idea and wrote the manuscript. Yu-wang Wang conducted the research program and designed the field investigation. Yu Shi analyzed the results.

Declaration of competing interest

The authors declare no conflicts of interest.

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