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Research Advances

Rb-Sr Dating of Sulfides from the Huogeqi Copper-Lead-Zinc Polymetallic Deposit in Inner Mongolia

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Objective

The Huogeqi copper-lead-zinc polymetallic deposit in Inner Mongolia is located in the western part of the Middle-Late Proterozoic Langshan rift trough situated on the northern border of North China Platform. Previous studies suggest that the Huogeqi deposit is a sedimentary exhalative deposit and that the main metallogenic epoch was the Middle-Late Proterozoic, with metallogenic superimposition or transformation in later period. There is a lack of necessary chronological evidence of ore sulfides, required to support mineralization events later. This work conducted Rb-Sr dating of sulfides to constrain the metallogenic epoch of this deposit, which provides good chronological evidence for the comprehensive study of copper-lead-zinc-iron mineralization in this area.

Methods

According to the different ore-hosted strata and ore characteristics of the Huogeqi deposit, the copper ore bodies are mainly distributed in banded quartzite, and the lead-zinc orebodies are mainly divided into the No.1 orebody and No.3 orebody, of which the No.1 orebody is mainly distributed in carbonaceous slate and the No.3 orebody is mainly distributed in diopside-tremolite carbonate. This sulfide samples were collected from the fresh lead-zinc ores in the No.1 orebody at No. 026 stope of No. 1630 middle section in No. 1 deposit. Ore bodies occur as stratiform or stratoid beds and the lead-zinc ores have the following characteristics: grey-black, ore texture with semi-automorphic-heteromorphic granular texture, corrosion texture, intergrow texture, metasomatic residual texture, etc., and main ore structure with disseminated structure, massive structure, banded structure, massive breccia structure. The metal minerals are mainly pyrrhotite, sphalerite, galena, a small amount of chalcopyrite and pyrite, as well as trace amount of arsenopyrite and marcasite. The gangue minerals are mainly quartz, carbonaceous, sericite, a small amount of diopside, tremolite, chlorite, etc.

The massive breccia lead-zinc ores were chosen and eleven samples of pyrrhotite, galena, and sphalerite minerals were selected from the ores. The processing of samples and testing of Rb-Sr dating were performed at the Nanjing Nantai Geological Testing Institute. The isotopic analyses of Rb and Sr were carried out on a VG 354 mass spectrometer with five collectors. The reproducibility and accuracy of isotope values were verified by running the Standard Reference Material NBS 987 and Laboratory Standard La Jolla, with a certified $^{87}Sr/^{86}Sr$ value of 0.710236±0.000007. The Rb-Sr isochron diagrams and calculations were achieved using Isoplot/ Ex_ver3.

Results

The test data of six samples of pyrite, two samples of galena, and three samples of sphalerite are shown in Appendix 1. The contents of Rb and Sr range from 0.1873 ppm to 2.7820 ppm and 1.817 ppm to 6.585 ppm, respectively, with the $^{87}Rb/^{86}Sr$ ratio of 0.1035–3.981 and the $^{87}Sr/^{86}Sr$ ratio of 0.709903±0.000008 to 0.724736±0.000008. The ratio of $^{87}Rb/^{86}Sr$–$^{87}Sr/^{86}Sr$ has a wide range of variation, which reveals that there are differentiations between Rb and Sr in sulfides. The isochron age of Rb-Sr is 267.2±2.5 Ma with MSWD of 1.5, obtained from seven data samples (Fig. 1), except Nos. 2, 3, 8 and 9 (due to discrete points). The age is relatively consistent with the weighted average age of 274.3±2.4Ma and MSWD of 1.17 for LA-ICP-MS zircon U-Pb from the No.3 orebody (unpublished), thereby confirming the formation of lead-zinc ores; hence, the dating results of No. 1 and No. 3 orebodies comprehensively indicate that the lead-zinc metallogenic epoch is mainly the Hercynian in the Huogeqi copper-lead -zinc polymetallic deposit.

Conclusions

Rb-Sr dating in the Huogeqi copper-lead-zinc polymetallic deposit shows that the lead-zinc metallogenic epoch is mainly the Hercynian, instead of the previously suggested Middle-Late Proterozoic. The metallogenic age of the deposit is similar to that of the Oubugela, Aerqitu and Kouketaolegai porphyry copper-gold deposits in the Langshan area, which indicates that large-scale hydrothermal mineralization events in this period are a

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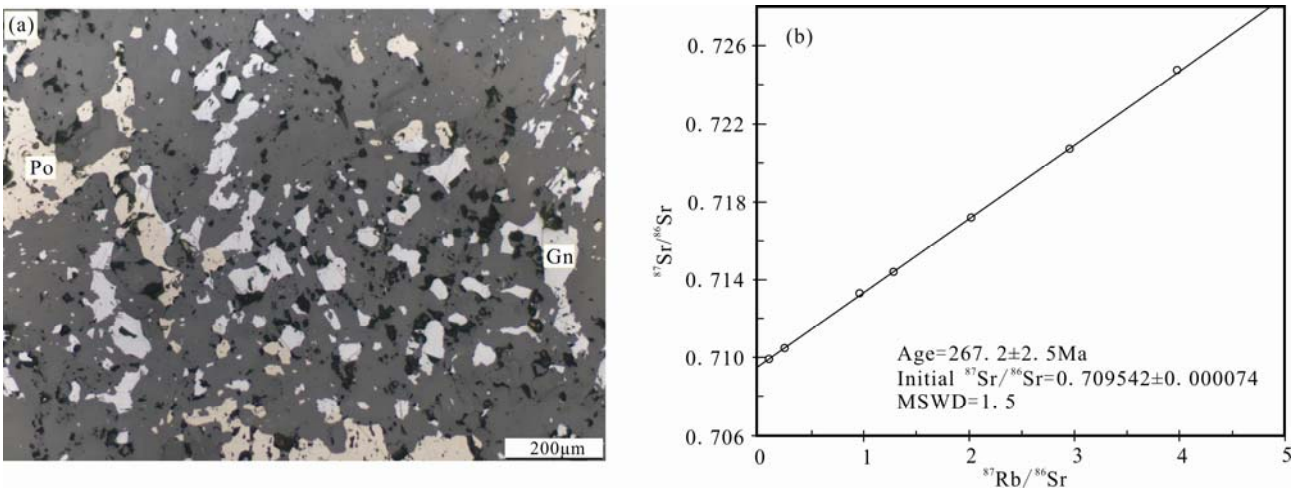

Fig. 1. Microphotograph of ores (a) and Rb-Sr isochron diagram of sulfides (b) from the Huogeqi copper-lead-zinc polymetallic deposit in Inner Mongolia.
Po, pyrrhotite; Gn, galena.

result of the Hercynian tectonic-magmatic activities in the Langshan area. This is the preliminary report on the Rb-Sr dating of sulfides of lead-zinc ores in the deposit. Additional research should be carried out on the metallogenic epoch of copper ores and iron ores in isotope dating in order to establish temporal and spatial relationships among copper, lead-zinc, and iron ores in the deposit.

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Appendix 1 Rb-Sr isotopic analyses for sulfides in the Huogeqi copper-lead-zinc polymetallic deposit

Order number	Sample number	Sample name	Rb (ppm)	Sr (ppm)	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr\pm2\sigma$
1	B1-1630	pyrrhotite	1.567	4.836	0.9512	0.713234±0.000009
2	B2-1630	pyrrhotite	1.829	2.207	2.432	0.717325±0.000016
3	B2-1630	sphalerite	0.8542	1.869	1.353	0.715492±0.000015
4	B3-1630	pyrrhotite	2.103	3.085	2.016	0.717243±0.000009
5	B3-1630	sphalerite	0.9316	2.162	1.278	0.714358±0.000007
6	B3-1630	galena	0.1873	2.209	0.2503	0.710507±0.000009
7	B4-1630	pyrrhotite	2.456	1.817	3.981	0.724736±0.000008
8	B7-1630	pyrrhotite	2.782	2.984	2.754	0.722078±0.000014
9	B8-1630	sphalerite	0.8427	2.458	1.016	0.712652±0.000013
10	B8-1630	pyrrhotite	1.984	1.979	2.947	0.720684±0.000007
11	B8-1630	galena	0.2309	6.585	0.1035	0.709903±0.000008