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Research Advances

Re-Os Isotopic Dating of a W-Be Polymetallic Deposit in the Southern Qinling Region, China

DAI Hongzhang, WANG Denghong*, WANG Chenghui and HUANG Fan

Key Laboratory of Metallogeny and Mineral Resource Assessment, Ministry of Land and Resources, Institute of Mineral Resource, Chinese Academy of Geological Sciences, Beijing 100037, China

Objective

In recent years, a series of tungsten prospecting breakthroughs have been made in the southern Qinling Mountains. Especially, a new deposit type with a scheelite -beryl-molybdenite assemblage in the Zhen'an area of Shaanxi Province was firstly discovered. This deposit is currently in a detailed investigation stage, and no detailed study has been yet conducted. This work selected one molybdenite sample from the Be (W) ores in this deposit for Re-Os isotope measurements to define the time limit of tungsten and beryllium mineralization, and to further reveal the ore-forming geological setting of rare metals in the southern Qinling region.

Methods

This work conducted both field geological survey and in -lab testing. The characteristics of mineral assemblages were observed by hand specimen and microscopy, and the molybdenite from the scheelite and beryl-bearing quartz vein type ores of phlogopite schist in the Ordovician–Silurian Liangchakou Fm. ((O–S)*l*) was chosen for Re-Os isotopic dating. The test methods were detailed in Song Mingchun et al. (2017).

Results

This deposit is located in Zhen'an County of Shaanxi Province, and is currently in a detailed investigation stage. It is expected that the tungsten ores will be large-scale and beryllium ores will be medium-scale. Molybdenum mineralization was penetrated by deep drilling, but its resources are not yet clear. The exposed strata from north to south are mainly Ordovician Liangchakou Fm. ((O–S)*l*) and Middle Ordovician Bailongdong Fm. (O_2b), and the vanadium-containing Lower Cambrian Shuigoukou Fm. ($\in_1 s$) was encountered by deep drilling, which is not exposed in the surface. No magmatic rocks have been discovered in the surface yet. The strike of W(Be) orebodies are approximately E-W trending, and the Be (W) orebodies are approximately S-N trending, both of which are deposited in the Liangchakou Fm. ((O–S)*l*) schist and the Bailongdong Fm. (O_2b) crystalline limestone and are mainly controlled by fault/fracture zones. The ore types are mainly calcite-quartz vein type for Be (W) and skarnoid type for W. Ore minerals include scheelite and beryl, as well as a small amount of molybdenite, wolframite and galenobismuthite. Gangue minerals are mostly quartz, calcite, dolomite, phlogopite, chrome mica, muscovite, diopside, tremolite, anhydrite and fluorite. The alteration types mainly include skarnoid, carbonation and silicification. The Hercynian thermal metamorphism mainly occurred in this mining area.

By hand specimen and microscopy observation, beryl is mostly euhedral (Figs. 1a, 1b and 1c), green-emerald in color, associated with scheelite and wolframite, which was formed earlier than molybdenite, pyrite and other sulfides (Figs. 1a and 1d). In addition, some particles have reached an emerald level (Fig. 1b), which reflects that the geological setting is closely related to the orogenic belt.

Through Re-Os isotope analysis, the model age of molybdenite, forming later than scheelite and beryl, is 196.3±3.3 Ma (Fig. 1d; Appendix 1), which can represent the lower limit of tungsten and beryllium metallogenetic age. This deposit was formed in the same period with other tungsten deposits in the same metallogenic belt, which further indicates that the formation of ore bodies maybe related to the Indo-Chinese-Yanshanian movement in this area. During this period, a strong extrusion nappe occurred in southern Qinling, and a series of longitudinal folds and brittle or brittle-ductile fault zones were formed by N-S trending over-thrust, which provide favorable conditions for the acidic or internediate-acidic intrusion from the Late Indosinian to the Early Yanshanian and after forming a large-scale tungsten (beryllium) mineralization.

* Corresponding author. E-mail: wangdenghong@sina.com

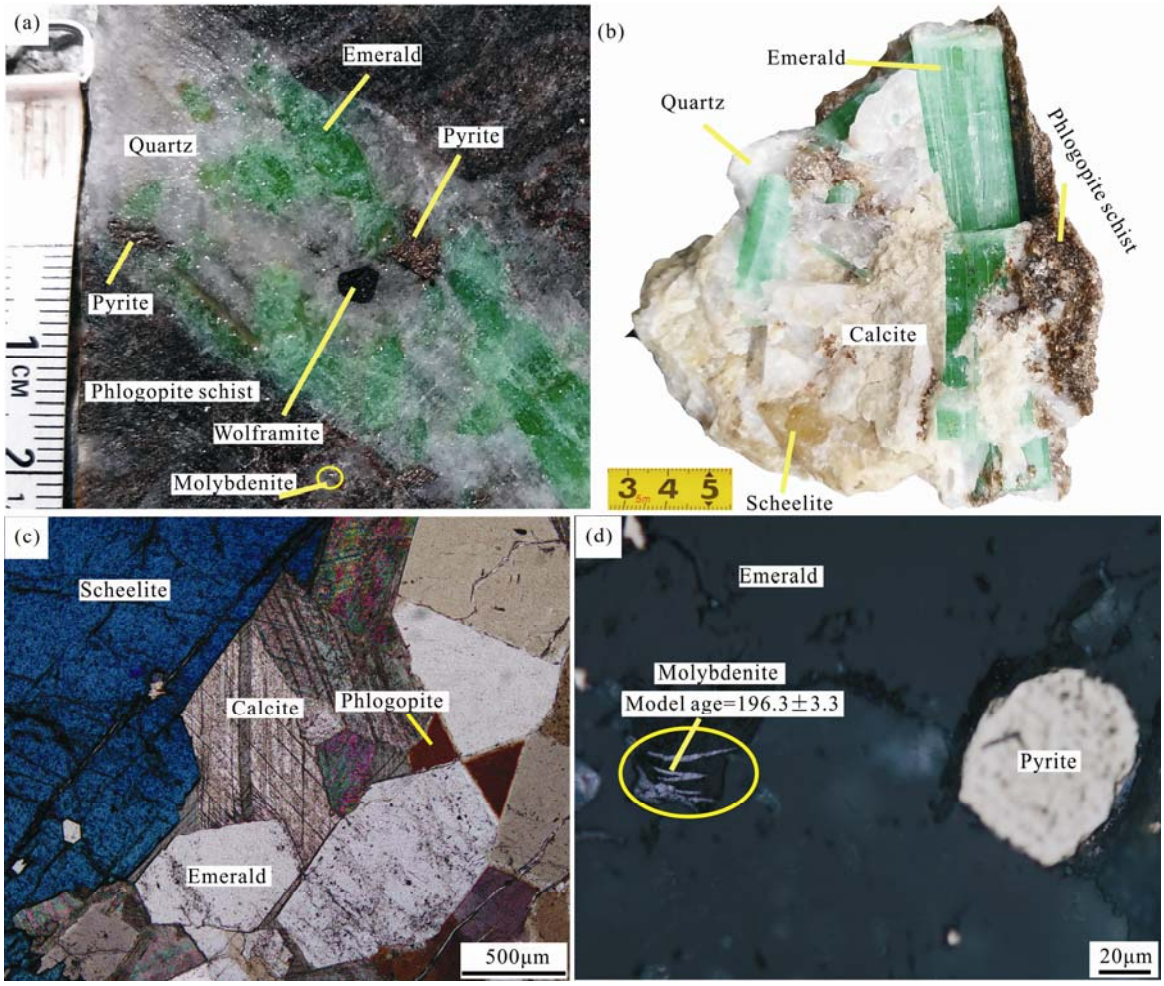

Fig. 1. Emerald-level beryl in calcite-quartz vein of phlogopite schist from the W-Be deposit in Zhen'an county, Shaanxi Province.
(a), Wolframite associated with beryl in quartz veins of phlogopite schist; (b), Emerald-level beryl hosted in calcite-quartz vein of phlogopite schist; (c), Idiomorphic scheelite and beryl; (d), Molybdenum hosted in beryl intercrystalline crack, a micrograph of Fig. 1a.

Conclusions

The precise Re-Os isotopic dating of molybdenite yields a model age of 196.3±3.3 Ma. It not only defines the lower limit of metallogenetic epoch of the W-Be polymetallic deposit as a new deposit type in the core of the Central Orogenic Belt, but also suggests that the formation of scheelite and beryl in the deposit is in a relatively stable stage after the strong orogeny during the Late Indosinian to the Early Yanshanian. Our novel discoveries and preliminary study could be conducive to a new direction for the regional and deep prospecting of rare metals in the southern Qinling region.

Acknowledgments

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References

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Appendix 1 Re and Os isotopic data for molybdenite from the W-Be deposit in Zhen'an county, Shaanxi Province

Location	Sample No.	Sample (g)	Re ppb (±2σ)	^{187}Re ppb (±2σ)	^{187}Os ppb (±2σ)	Model age (±2σ)
Zhen'an County	ZA-1	0.03032	85321±990	53626±622	175.63±1.22	196.3±3.3