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The Study on Material Source of the Leimengou Mo Deposit in West Henan Province, China:Constraints from Zircon Hf Isotope and S Isotope Data

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1 Introduction

The East Qinling molybdenum (Mo) belt, extending from the San-Bao Fault in the north to the Shang-Dan Fault in the south, is one of the world's most important Mo ore district, with measured reserves of more than 8 Mt of Mo metal(Mao et al., 2011). Generally, Mo mineralization is closely related to small intermediate-silicic porphyry intrusions of the Mesozoic era and porphyry and porphyry-skarn types form the vast majority of Mo deposits in the East Qinling area. The Leimengou Mo deposit is typical of porphyry type deposits in the East Qinling Mo belt. As a large-scale deposit, the detailed studies on the geology, geochemistry, geochronology and ore-forming fluid geochemistry has been done (Chen et al., 2014). In this paper, the signatures of zircon Hf isotope and S stable isotope of pyrite and molybdenum are presented in order to understand the sources of the granite porphyry associated with Mo mineralization and ore-forming materials.

2 Geological Characteristics

The Leimengou porphyry Mo deposit is located in Songxian County, Henan Province. The exposed strata in the mine area comprise the Neoarchean Taihua Group, consisting of biotite plagioclase gneisses. Igneous rocks include Neoproterozoic abbro-diabase, dacite porphyry and Mesozoic porphyry syenite stocks, granite porphyry stocks and related explosive breccia, quartz porphyry, and monzonitic granite dykes. Mesozoic granite porphyry (136.2±1.5Ma, Li et al., 2006) is temporally and spatially associated with Mo mineralization (132.4 ±1.9Ma, Li et al., 2006) and cover an area of 0.77km^2. The ore-hosting porphyry are pale pink to grayish white in color with fine-grained granitic and porphyritic textures, and comprise 75-80% of phenocrysts of K-feldspar, plagioclase, quartz, and 20-25% of groundmass of K-feldspar, quartz, and minor biotite. The geochemical composition of the rocks shows that they are characterized by high K, high Si, and low Ca and Mg, and that they are calc-alkaline (Yan et al., 1986). The molybdenite as well as pyrite mainly occurs in the contact zone between the Neoarchean Taihua Group strata.

3 Zircon Hf isotope Compositions

In situ zircon Lu-Hf isotopic analyses were performed on cores and rims of 24 zircon grains from the granite porphyry, dated at 131.1±0.6Ma. The analyzed zircons have present-day Hf isotopic compositions with a fairly narrow variation from 0.281907 to 0.282215 with corresponding the initial $^{176}Hf/^{177}Hf$ values from 0.281903 to 0.282212. This corresponds to a range in present-day εHf values from -27.9 to -16.9, yielding Hf $T_{DM(C)}$ ages of 2.26-2.95 Ga, peaking at 2.4-2.7Ga.

These data (plotted on a εHf vs. the corresponding crystallization age diagram, Fig. 1) indicate that the Leimengou granite porphyry derived mostly from an ancient continental crust. Previous studies (Xu et al., 2009; Shi et al., 2011) show that the TTG gneisses from Taihua Group formed during the Neoarchean (2.84 to 2.76Ga), and the plagioclase gneisses of Taihua Group formed during the Neoarchean (2.84 to 2.54Ga) and Paleoproterozoic (2.3 to 2.5 Ga). In this study, the Hf $T_{DM(C)}$ age of the Leimengou granite porphyry is 2.26-2.95 Ga consistent with the Taihua Group, indicating that the source magma mainly comprised the reworked Taihua Group materials. However, the εHf values calculated by the Hf isotope data from of the Taihua Group when t=131Ma, are lower than the Leimnggou instrusion. Therefore primary sources may contain small amounts of juvenile components. Previous studies demonstrate that

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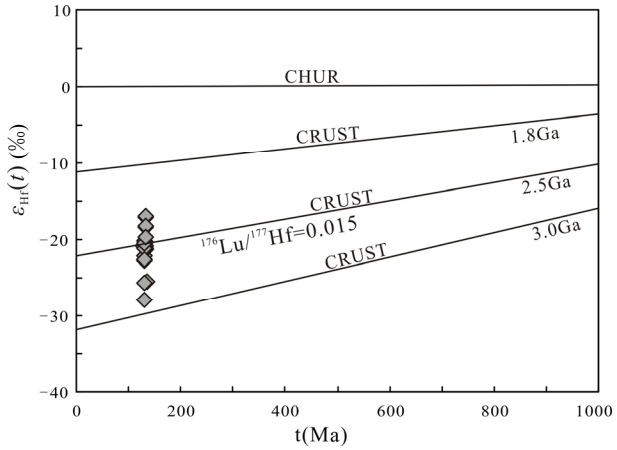

Fig.1. Diagram of εHf values vs. $^{206}Pb/^{238}U$ ages of zircons from the Leimengou granite porphyry

Table 1 Sulfur isotope data of the Leimengou deposit.

Sample No.	Mineral	$\delta^{34}S$ (‰)
B1/LMG	Molybdenite	-0.4
B2/LMG	Molybdenite	1.2
B3/LMG	Molybdenite	0.7
B4/LMG	Molybdenite	-0.9
B5/LMG	Molybdenite	1.5
B6/LMG	Molybdenite	-0.3
B25/LMG	Molybdenite	-0.8
B10/LMG	Pyrite	2.1
B11/LMG	Pyrite	2.6
B26/LMG	Pyrite	2.9
B27/LMG	Pyrite	2.3

the Early-Middle Cretaceous granite porphyries and related deposits in the East Qinling area are due to lithospheric thinning, asthenospheric upwelling, and partial melting of the crust (Mao et al., 2011), indicting some mantle contributions.

4 S Isotopes

Sulfur isotopic compositions for 7 molybdenite samples and 4 pyrite samples from the Leimengou Mo deposit are shown in Table 1. The $\delta^{34}S$ (‰) values of the 7 molybdenite are between -0.9 and +1.5, averaging 1.4, whereas the $\delta^{34}S$ (‰) values of the 4 pyrite are between 2.1 and 2.9, averaging 2.5. These values are suggestive of sulfur from a deep igneous source.

5 Conclusions

The source magma of Leimengou granite porphyry related to Mo mineralization were derived from the melting of ancient continental crust (probably Neoarchean-Paleoproterozoic Taihua Group), with the addition of juvenile components. The ore-forming materals derived from a deep igneous source.

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