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Genetic Model of Mayuan MVT Lead-Zinc Deposit along the Northern Margin of the Yangtze Block

HU Peng[1] and LI Changshou[2]

1 Wuhan center of China Geological Survey, Wuhan, Hubei, 430223
2 The Sixth Geological Team, Bureau of Geology and MineralExploration of Shaanxi Province, Xi'an, Shaanxi, 710611

As a significant breakthrough of prospecting along the northern margin of the Yangtze Block, the Mayuan large-sized carbonate-hosted Zn–Pb deposit had been explored in the Nanzheng County, Shaanxi Province, recently. This Zn–Pb deposit occurs along the margin of Hannan paleocontinent and is hosted by the dolomites of the Sinian Dengying Formation. In this paper, on the basis of the trace elements LA-ICP-MS research of sphalerites from the Mayuan Zn–Pb deposit, combined with the previous studies of isotope geochemistry, ore-forming fluids, and metallogenic chronology in this deposit, we propose a possible model for the mineralization of this large-sized deposit.

1 Traceelement Geochemistry of Sphalerites (LA-ICPMS): Implication for the Genetic Type and Physical-chemical Conditions

The LA-ICPMS result for the trace elements of sphalerites revealed that the sphalerites are with low content of Fe (0.28%~0.57%), Mn (35.08×10^{-6}~47.82×10^{-6}), as well as In (the highest content is 0.59×10^{-6}). But the high content of dispersed elements Cd (1002.45×10^{-6}~1616.18×10^{-6}), Ge (368.86×10^{-6}~784.41×10^{-6}) and Ga (11.18×10^{-6}~89.74×10^{-6}) are detected. This feature is obviously different from the magmatic-related meso-hydrothermal Zn–Pb deposits which are commonly with the higher content of Fe and Mn, higher or lower content of In, but lower content of Ge. Whereas, the characteristic of trace elements in sphalerites from the Mayuan deposit is very similar to the other MVT Zn–Pb deposits (Ye et al., 2011) and suggest it could be classified as the MVT deposit. Moreover, the formation temperature of sphalerites are estimated to range from 178.6℃ to 238.7℃ and with the average temperature of 210.3℃ using the LogGa/Ge-T diagram, which is consistent with the study of fluid inclusions. It is indicated that sulfide of the deposit formed from ore-forming fluids with medium-low temperature and could be related to the basinal fluids.

2 Sources and Ore-forming Fluids for Mineralization

The sulfides of this deposit have the large positive $\delta^{34}S$ values (+12.94 to +19.4‰), which indicates that the reduced S is probably derived from the thermochemical sulfate reduction (TSR) of seawater sulfates by the plentiful organic matter in this deposit (Hou et al., 2007; Li et al., 2007; Wang et al., 2008). Lead isotope of sulfides in the deposit had the relatively uniform components ($^{206}Pb/^{204}Pb$ = 17.62~18.02, $^{207}Pb/^{204}Pb$ = 15.49 ~ 15.63, $^{208}Pb/^{204}Pb$ = 37.57~38.35) and indicates the upper crust sources for the Zn–Pb mineralization. Homogenization temperature of inclusions in sphalerites ranged from 100 to 300℃, but mostly are less than 250℃, which is presented in typical medium-low temperature fluids. The salinity offluid inclusions range from 7.9% to 17.6%(wt.% NaCl) and most of them are higher than 10% (wt.%NaCl) (Wang et al., 2008; Liu et al., 2012). The Mayuan Zn–Pb deposit may have formed from the ore-forming fluids with low-to-moderate temperatures and moderate salinity.

3 The Time and Possible Model for the Mineralization

The Caledonian age (~486 Ma) was yielded by Rb-Sr dating of sphalerites(Li et al., 2007).In addition, the initial $^{87}Sr/^{86}Sr_{t=486}$ values of the sphalerites suggest that the ore-forming fluids of the Mayuan Zn–Pb deposit may have originated from the sedimentary strata rather and could be reacted with basement rocks and/or shale to extracted the metals.

In summary, the genetic model for the mineralization of

* Corresponding author. E-mail: 157521303@qq.com

the Mayuan MVT Zn–Pb is proposed as follows: During Early Ordovician, under the impact of the Caledonian uplift inside the cratonic basin in Middle and Upper Yangtze region, the basin fluid migrated from uplift area to paleocontinent due to gravity-induced, and then deposited in the interlayer gliding fracture zone under the unconformity between Cambrian and simian strata in the margin of paleocontinent. In addition, the Qinling area is tectonic active area; hence, the possibility ore-forming after mineralization could not be excluded (such as the impact of Indosinian orogenic event).

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