



Ore Genesis of the Taoyuan Pb-Zn Deposit, Liaoning Province: Evidence from Characteristics of S and Pb Isotopic Compositions

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Abstract: Qingchengzi Pb-Zn-Au-Ag ore concentration area located in the eastern of Liaoning province, there are a large number of Pb-Zn deposits, gold deposits, silver deposits in it (Ma et al., 2016). There have been dispute on the ore genesis in Qingchengzi ore concentration area, three controversial views are (a) Metamorphic hydrothermal mineralization (Duan et al., 2014) (b) Magmatic hydrothermal mineralization (Yu et al., 2009; Duan et al., 2017), (c) polygenetic mineralization (Liu et al., 2019). Taoyuan Pb-Zn deposit is located in the middle of Qingchengzi ore concentration area. There are two kinds of lithology in it. One is marble from Dashiqiao formation, and the other is schist from Gaixian formation. The host strata of orebodies is the third paragraph of Dashiqiao formation thick dolomite marble. There are some granite-porphyry and lamprophyre dykes in it. Structure is more development, the NE-trending of Erdaogou fault controlled the distribution of most of the Pb-Zn deposit. Near the Taoyuan Pb-Zn deposit, it is tend to EW-trending extends to Jianshanzi fault. The most favourable metallogenic space is the transition site of structure. The orebodies have some zonation characteristics with “upper is vein and lower is layer” and “upper is Pb and lower is Zn”. As the deposit was found recently, the research work were barely carried out yet. Based on the study of mineral composition, ore structure, Systematically carried out the study of S and Pb isotopic in Taoyuan Pb-Zn deposit, We try to trace metallogenic material source and genesis of the deposit.

The analysis Results of sulfur isotopic show that: The $\delta^{34}\text{S}$ values of the sulfides from Taoyuan Pb-Zn deposit range from 3.5‰ to 8.9‰, with an average of 5.52‰, which can be explained mantle source. The sulfur isotopic in Taoyuan and Qingchengzi Pb-Zn deposit both have tower distribution characteristics obviously, showing that the sulfur isotopic in Taoyuan Pb-Zn deposit derived from the mantle source on the whole. There are two samples of the $\delta^{34}\text{S}$ value is higher (8.6‰ and 8.9‰, respectively), and showed a mixed characteristics of sulfur, Not all $\delta^{34}\text{S}$ value is located in the granite within the scope of a small amount of samples from this range, informing to relate to hydrothermal metasomatic rock or other mixture. Thus it can be seen that S isotopic in the Taoyuan Pb-Zn deposit mainly comes from the Indosinian intrusive, and may be mixed

with a small amount of strata sulfur from Liaohé group.

The sulfide from Taoyuan Pb-Zn deposit give the lead isotopic ratios of 17.969–18.309 for $^{206}\text{Pb}/^{204}\text{Pb}$, with an average of 18.076; 15.572–15.669 for $^{207}\text{Pb}/^{204}\text{Pb}$, with an average of 15.617, and 38.222–38.371 for $^{208}\text{Pb}/^{204}\text{Pb}$, with an average of 38.312. The μ values range from 9.46 to 9.61 (average at 9.55), and the μ values in Qingchengzi Pb-Zn-Au-Ag deposit and the Indosinian intrusive is relatively close, the main change in 9.38–9.66 (average 9.52), which suggest that Pb isotopic has the characteristics of crust-mantle mixed source, and the mineralization is related to magmatism. On the drawing of Pb isotopic structure pattern diagram, the Pb isotopic values in Qingchengzi Pb-Zn-Au-Ag deposit and Indosinian intrusive cut the three growth curve of Pb source area. Most of the samples between upper crust and orogenic belts, which is close to the evolution of orogenic belt line. It suggests that they may have the same source or evolution process, and the apparent linear trend is usually considered that the Pb has the characteristics of mixed sources.

On the Pb isotopic genetic classification diagram, Pb isotopic of the ore in Taoyuan Pb-Zn deposit and Qingchengzi Pb-Zn-Au-Ag ore concentration area, the pyrite in Indosinian intrusive landed on the subduction-zone type lead ranges in which the upper crust and mantle are mixed, which inform to relate to magmatism closely. This indicates that the Taoyuan Pb-Zn deposit was formed in the same tectonic environment as the nearby Qingchengzi Pb-Zn-Au-Ag ore and the Indosinian intrusive. The sources of Pb-Zn ore and Au-Ag ore in Qingchengzi are may be derived from deep magmatic fluid. They constitute a set of Pb-Zn-Au-Ag mineralization system. The metallogenic materials come from the mixed source area of crust-mantle, not from the stratum. Therefore, the Pb-Zn-Au-Ag deposit in Qingchengzi ore concentration area is magmatic hydrothermal deposit, not the “strata-bound” deposit as the predecessors said.

Key words: S and Pb isotopic, source of ore-forming materials, Taoyuan Pb-Zn deposit, Qingchengzi ore concentration area, Liaodong

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References

- Duan, X.X., Zeng, Q.D., Wang, Y.B., and Zhou, L.L., 2014. Sources of Qingchengzi Pb-Zn orefield: implications from Pb isotope. *Acta Geologica Sinica*(English Edition), 88(sup. 2):1604–1606.
- Duan, X.X., Zeng, Q.D., Wang, Y.B., Zhou, L.L., and Chen, B., 2017. Genesis of the Pb-Zn deposits of the Qingchengzi ore field, eastern Liaoning, China: Constraints from carbonate LA-ICP-MS trace element analysis and C-O-S-Pb isotopes. *Ore Geology Reviews*, 89:752–771.
- Liu, J., Liu, F.X., Li, S.H., and Lai, C.K., 2019. Genesis of the Xiaotongjiapuzi gold deposit of the Liaodong gold province, Northeast China: Fluid inclusion thermometry and S-Pb-H-O-He isotope constraints. *Geological Journal*, 1–18.
- Ma, Y.B., Bagas, L., Xing, S.W., Zhang, S.T., Wang, R.J., Li, N., Zhang, Z.J., Zou, Y.F., Yang, X.Q., Wang, Y., and Zhang, Y., 2016. Genesis of the stratiform Zhenzigou Pb-Zn deposit in the North China Craton: Rb-Sr and C-O-S-Pb isotope constraints. *Ore Geology Reviews*, 79: 88–104.
- Yu, G., Chen, J.F., and Xue, C.J., 2009. Geochronological framework and Pb, Sr isotope geochemistry of the Qingchengzi Pb-Zn-Ag-Au orefield, Northeastern China. *Ore Geology Reviews*, 35: 367–382.

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