LI Wei, XIE Guiqing, ZHU Qiaoqiao, SONG Yingxin, ZHANG Zhiyuan, 2014. Oxygen Isotope Study of Magnetite from Chengchao Iron Deposit, Southeastern Hubei Province. *Acta Geologica Sinica* (English Edition), 88(supp. 2): 95-96.

Oxygen Isotope Study of Magnetite from Chengchao Iron Deposit, Southeastern Hubei Province

LI Wei[1,2], XIE Guiqing[2], ZHU Qiaoqiao[2], SONG Yingxin[1], ZHANG Zhiyuan[1]

1 *Faculty of Sciences and Mineral Resources, China University of Geosciences, Beijing 100083, China;*
2 *MLR Key Laboratory of Metallogeny and Mineral Assessment, Institute of Mineral Resources, Chinese Academy of Geological Sciences,Beijing 100037,China*

1 Introduction

The Chengchao iron deposit, which contains 270 Mt Fe ores, is the largest skarn iron deposit in the Middle-Lower Yangtze River Valley metallogenic belt, which is a world class Fe-Cu-Au polymetallic ore belt. Therefore, study the ore genesis of Chengchao iron deposit has crucial scientific and economic significance, but its ore genesis has long been contentious, mainly including the follow opinions: (1) directly from ore magma (Shi et al., 1981), (2) both ore magma and hydrothermal metasomatism (Zhai et al., 1992), (3)hydrothermal metasomatism (Shu et al.,1992; Xie et al.,2012). It can be obviously seen that these debates mainly focus on whether there exited ore magma processes. Magnetite, as the most important ore mineral, can provide convincing evidence to constraint this debate. Previous studies show that there are obvious differences on composition and oxygen isotope of magnetite from both typical ore magma and hydrothermal replacement deposits. Meanwhile, the EMP analyses on the magnetite indicate that the magnetite were formed through hydrothermal metasomatism of the marine carbonates by magmatic-derived fluids in the Chengchao deposit (Hu et al., 2014). In this contribution, oxygen isotope analyses of magnetite samples without multiple generations were carried out, aiming to further constraint on the ore genesis and ore formation process.

2 Oxygen Isotope Analytical Results of Magnetite

Oxygen isotopic results of 11 magnetite samples show that the different occurrence of magnetite have distinguished $\delta^{18}O$ values, which can be divided into two groups specifically: the $\delta^{18}O$ values of magnetite in massive ores have a narrow range from 4.5‰ to 4.8‰, and the $\delta^{18}O$ values of magnetite in disseminated ores that mostly replace other minerals (such as garnet, diopside, epidote and amphibole) are from 0.9 to 2.6‰.

3 Discussion and Conclusion

The different types of magnetite in specific deposit that were precipitated from the same fluid during the constant temperature have similar $\delta^{18}O$ values (Zheng, 1995). Based on the isotope fractionation equation for magnetite-water (Zheng, 1995), even though the magnetite were precipitated from the same fluid that have 600℃ temperature interval, the $\delta^{18}O$ values show narrow variations up to 3.06‰. As noted above, there have a wide range of $\delta^{18}O$ for the magnetite at Chengchao, indicting the magnetite in Chengchao iron deposit was precipitated from different fluids (Jonsson et al., 2013). According to the decrepitation temperature of magnetite and the homogeneous temperature of fluid inclusions in gangue minerals of different stages (Shu et al.,1992;unpublished data), the inferred formation temperature of magnetite from both in massive and disseminated ores are mainly between 450~600℃. Based on the isotope fractionation equation for magnetite-water (Zheng, 1995), the calculated $\delta^{18}O_{H2O}$ are higher than 10‰ in massive ores, which is above the range of magmatic water (5.5-10‰, Hoefs, 2009), but the calculated $\delta^{18}O_{H2O}$ are within 7.0~10‰ in disseminated ores.

The high $\delta^{18}O_{H2O}$ of magnetite in the massive ore may be the result of reaction between magmatic fluid and country rocks that rich in $\delta^{18}O$ (Rose et al.,1985). Previous studies have shown that the $\delta^{18}O$ of the Triassic limestone in Southeastern Hubei province is near +23‰ (Zhai et al.,1992). In contrast, the $\delta^{18}O$ of altered marble at Chengchao ore district is lower (+15.1‰, unpublished data), indicating that the magmatic fluid and wall rock had

* Corresponding author. E-mail: liwei2012cugb@163.com

been reacted and exchanged $\delta^{18}O$ with each other (Rose et al.,1985). This conclusion is also supported by the sulfur isotope of sulfide and sulfate, suggesting that the evaporate salt layer was participated in the ore formation process (Xie et al., 2013). Owing to the changing of physical and chemical conditions, magnetite directly precipitated from this kind of $\delta^{18}O$-riched fluid, resulting in the magnetite have higher $\delta^{18}O$ value, and ore bodies have many breccias that are mainly plutonic rocks and skarn. Followed by the increasing addition of meteoric water, the $\delta^{18}O$ value of the fluid decreased. As the hydrolysis action become progressively intensive, the early skarn minerals were replaced by the retrograde stage minerals, such as epidote, amphibole, phlogopite, chlorite and large amounts of magnetite. The magnetite in disseminated ores have lower $\delta^{18}O$ value (0.9‰~2.6‰). The mixing of meteoric water was also revealed by the He-Ar isotope of pyrite (Li and Xie, 2013).

Combined with Oxygen isotope and composition characteristics of magnetite (Hu et al., 2014), it can be inferred that the magnetite in Chengchao iron deposit were formed by skarnation rather than from ore magma, and the way of mineralization are both filling and replacement.

Acknowledge

I would like to thank Zheng Xianwei Zheng senior engineer and other geologists from Chengchao iron mine of the Wuhan Iron＆steel Group Minerals Co., Ltd, China for the field investigation. I express my appreciation to Professor Wan Dengfang Wan for their great assistance during the process of oxygen isotope analysis. This research has been supported by the National Basic Research Program of China (2012CB416802).

Reference

Hoefs, J,, 2009. Stable Isotope Geochemistry. Publication: Springer-Verlag, Berlin, Heidelberg, New York.

Hu Hao, Li Jianwei, Lentz David, Ren Zhe, Zhao Xinfu, Deng Xiaodong and Hall Douglas, 2014. Dissolution -Reprecipition Process of Magmatite from Chengchao Iron Deposit: Insight into Ore Genesis and Implication for in-situ Chemical Analysis of Magnetite. .Ore Geology Review, 57:393-405.

Jonsson, E., Troll, V.R., HÖgdahl, K, Harris, C., Weis , F., Nilsson, K.P and Skelton, A, 2013. Magmatic Origin of Giant 'Kiruna-Type' Apatite-Iron- Oxide Ores in Central Sweden. Scientific Report,1644:1-8.

Li Wei and Xie Guiqing, 2013. The Source of fluid in Chengchao skarn iron deposit, Southeastern Hubei ore cluster. Acta Mineralogica Sinica(S2): 20-20.

Rose, A.W., Herrick, D.C. and Deines, P., 1985. A Oxygen and sulfur isotope study of skarn-type magnetite deposits of the Cornwall type, Southeastern Pennsylvania. Economic Geology, 80:418-443.

Shi Zhunli, Jin Zhenmin, Xiong Pengfei, Wang Dingyu and Huang Kehuan, 1981. A preliminary discussion on problems of ore-magma mineralization of "Daye type"iron deposit at Tieshan,Hubei. Earth Science,(2):145-154.

Shu Quanan, Chen Peiliang, Cheng Jianrong, et al, 1992. Geology of iron-copper deposits in Eastern Hubei province, China. Metallurgic Industry Press,1-532.

Xie Guiqing, Mao Jingwen, Zhao Haijie, Duan Chao and Yao Lei, 2012. Zircon U-Pb and phlogopite ^{40}Ar-^{39}Ar age of the Chengchao and Jinshandian skarn Fe deposits, Southeast Hubei province, Middle-Lower Yangtze river valley metallogenic belt,China. Miner Deposita,47:633-652.

Xie Guiqing, Zhu Qiaoqiao, Yao Lei, Wang Jian and Li Wei. 2013. Discussion on regional metal mineral deposit model of late Mesozoic Cu-Fe-Au polymetallic deposits in the Southeast Hubei province. Bulletin of Mineralogy, Petrology and Geochemistry,32(4):418-426.

Zhai Yusheng, Yao Shuzhen, Lin Xinduo, Zhou Xunruo, Wan Tianfeng, Jin Fuquan and Zhou Zonggui, 1992. Fe-Cu（Au）Metallogeny of the Middle-Lower Changjiang region. Beijing: Geological Publishing House,1-235.

Zheng Yongfei, 1995. Oxygen isotope fractionation in magnetites: structure effect and oxygen inheritance. Chemical Geology,121: 309-316.