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The Role of Evaporites in the Genesis of the Jinshandian Skarn Fe Deposit in the Edong District, Middle–Lower Yangtze River Metallogenic Belt, China

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1 Introduction

Evaporites, which consist of salt, gypsum, anhydrite and other salt minerals, has played an important role in the formation of sedimentary-hosted and magmatic hydrothermal deposit, the later include IOCG (Barton and Johnson, 1996) and skarn Fe-Cu deposits (Pan and Dong,1990). Previous studies show that it is probably a critical controlling factor to lead the formation of high-grade skarn Fe deposits (Li et al., 2013), but there are little known that how did the evaporites attended into the ore-forming system.

2 Deposit Geology

The Jingshandian skarn Fe deposit is a typical representative of skarn deposit of Edong ore district, one of the most richly-endowed skarn Fe-Cu district in China (Zhai et al., 1996, Xie et al., 2012), and located in the westernmost part of the Middle–Lower Yangtze River metallogenic belt, which extended along the northern margin of Yangzi craton (Mao et al., 2006). It is a large iron deposit with significant amounts of cobalt and anhydrite as by-products (Shu et al.1992). Two major mineralized localities named Zhangfushan and Yuhuashi, located in the south and northwest contact zone between the Jinshandian pluton with carbonate and clastic formations, respectively. The Jinshandian pluton is dominantly of quartz diorite and quartz monzonite in petrology. Low-Middle Triassic strata can be recognized as important host ore sedimentary rocks, including the Daye, Jialingjiang and Puqi Formation. Of those, the Jialingjiang Formation consists of medium to thick-bedded dolomite, dolomitic limestone, and intercalating with thick evaporites layers. Over 130 Fe ore bodies occurred as lenticular and vein shape and distributed more than 2km along the NW to NWW-striking fault at the contact zone with a width of more than 100m, which composed mainly of primary magnetite and minor martite after magnetite (Shu et al., 1992).

3 Samples and Results

3.1 Evaporites related minerals

As a kind of sodic alteration, scapolite was mainly developed in the endoskarn which can be subdivided into three types basing on texture and mineralogy: (1) columnar crystal accumulate as veinlet crosscutting the diopside skarn, with big miarolitic cavity inside and little euhedral magnetite and pyrite filling the space between crystals; (2) tabular crystal having well-developed cleavages and with a serrate margin replaced by magnetite to formed granophyric ores types; (3) only as veinlet crosscutting weakly diopside altered hornfels. Scapolites were often partly altered by albite, epidote and titanite, which changed the sacpolite from colorless to colorful.

Two kind of anhydrite were recognized in the Jinshandian skarn Fe deposit, which were grown at the stage of sulfide-anhydtite and carbonate, respectively. The former was observed as intergrowth with pyrite and widely developed as disseminated filling in the crack of massive magnetite ores and as a part of banded ores, as well as veins cutting the ores and skarns. Partly formed anhydrite (gypsum) deposits when connect with or in the wall rocks at Yuhuashi mine and contain a anhydrite (gypsum) confirmed reserve of ~197 million tons. two generations of pyrite were developed, as fine-grains intergrowth with magnetite in the space between scapolite crystals or with anhydrite more frequently in skarns or

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ores.

The scapolite samples were selected from the first and second type, anhydrite and pyrite samples were selected emphasizing those from veins in massive ores and skarns, mainly provided two coexisting sulfur-bearing minerals, and also with some has anhydrite or pyrite only.

3.2 Results

EMPA analysis shows that the Cl content of the scapolite ranged from 3.50% ~ 4.07% , higher than that of the Daye skarn Fe-Cu deposit of Edong distract, which was thought to be originated from hydrothermal brines from associated evaporites (Pan and Dong, 2003).

The $\delta^{34}S$ values of anhydrite have a range from 24.9‰ to 27.9‰ (n=10), and those of the gysum are 27.5and 28.4‰ (n=2), all of the value of the sulfates are significantly enriched in ^{34}S relative to pyrite, which has a range of 16.2 ‰ to 19.4 ‰ (n = 9).

4 Discussion and Conclusions

The ranges of $\delta^{34}S$ values of anhydrite and gypsum are closed to that of anhydrite in strata of the Low to Middle Triassic of the Middle Low Yangze River(~27‰ (Zhang et al., 1986), suggesting that the evaporites was involved into the source of sulfur in the ore-forming system. The S isotope geothermometer calculated temperatures for coexisting anhydrite–pyrite pairs（n=6) are 563℃~728℃, which is much more higher than the homogenization temperature of fluid inclusions of anhydrite coexisting with pyrite.

The Cl content in scapolite are as high as 4%, indicating NaCl equiv（wt%) of the fluid could have reached up to 70% (Ellis, 1978). These features provide compelling evidence the involvement of evaporites (Barton and Johnson, 1996). As one of the main mineral of early stage, Cl-rich scapolite can also indicate that evaporites had joined in the ore-forming system at high temperature, probably during the stage of magmatic to hydrothermal transformation or even much more earlier.

Dissolution of evaporites had critical contribution to increasing the salinity of the fluid, which enhanced the capacity of leaching and transporting of Fe (Fein et al., 1992) and the solubility of anhydrite (Newton et al., 2005) at high temperature. With amounts of anhydrite reduction in the ore-forming system, the oxidation state of the system was changed obviously, which was intensively needed by precipitation of large amounts of magnetite.

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