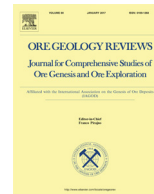




Contents lists available at ScienceDirect

Ore Geology Reviews

journal homepage: www.elsevier.com/locate/oregeo

Constraints on the mineralization processes of the Makeng iron deposit, eastern China: Fluid inclusion, H–O isotope and magnetite trace element analysis

Yu-Long Yang, Pei Ni^{*}, Jun-Yi Pan, Guo-Guang Wang, Ying-Feng Xu

State Key Laboratory for Mineral Deposits Research, Institute of Geo-Fluids, School of Earth Sciences and Engineering, Nanjing University, Nanjing 210023, China

ARTICLE INFO

Article history:

Received 3 May 2016

Received in revised form 20 November 2016

Accepted 22 November 2016

Available online xxxx

Keywords:

Skarn

Magnetite

Fluid inclusion

Stable isotope

Makeng iron deposit

Yong'an-Meizhou depression belt

ABSTRACT

The Makeng iron deposit is located in the Yong'an-Meizhou depression belt in Fujian Province, eastern China. Both skarn alteration and iron mineralization are mainly hosted within middle Carboniferous–lower Permian limestone. Five paragenetic stages of skarn formation and ore deposition have been recognized: Stage 1, early skarn (andradite–grossular assemblage); Stage 2, magnetite mineralization (diopside–magnetite assemblage); Stage 3, late skarn (amphibole–chlorite–epidote–johannsenite–hedenbergite–magnetite assemblage); Stage 4, sulfide mineralization (quartz–calcite–fluorite–chlorite–pyrite–galena–sphalerite assemblage); and Stage 5, carbonate (quartz–calcite assemblage). Fluid inclusion studies were carried out on inclusions in diopside from Stage 2 and in quartz, calcite, and fluorite from Stage 4.

Halite-bearing (Type 1) and coexisting two-phase vapor-rich aqueous (Type 3) inclusions in the magnetite stage display homogenization temperatures of 448–564 °C and 501–594 °C, respectively. Salinities range from 26.5 to 48.4 and 2.4 to 6.9 wt% NaCl equivalent, respectively. Two-phase liquid-rich aqueous (Type 2b) inclusions in the sulfide stage yield homogenization temperatures and salinities of 182–343 °C and 1.9–20.1 wt% NaCl equivalent. These fluid inclusion data indicate that fluid boiling occurred during the magnetite stage and that fluid mixing took place during the sulfide stage. The former triggered the precipitation of magnetite, and the latter resulted in the deposition of Pb, Zn, and Fe sulfides. The fluids related to magnetite mineralization have $\delta^{18}\text{O}_{\text{fluid-VSMOW}}$ of 6.7–9.6‰ and δD of –96 to –128‰, which are interpreted to indicate residual magmatic water from magma degassing. In contrast, the fluids related to the sulfide mineralization show $\delta^{18}\text{O}_{\text{fluid-VSMOW}}$ of –0.85 to –1.04‰ and δD of –110 to –124‰, indicating that they were generated by the mixing of magmatic water with meteoric water. Magnetite grains from Stage 2 exhibit oscillatory zoning with compositional variations in major elements (e.g., SiO_2 , Al_2O_3 , CaO, MgO, and MnO) from core to rim, which is interpreted as a self-organizing process rather than a dissolution–reprecipitation process. Magnetite from Stage 3 replaces or crosscuts early magnetite, suggesting that later hydrothermal fluid overprinted and caused dissolution and reprecipitation of Stage 2 magnetite. Trace element data (e.g., Ti, V, Ca, Al, and Mn) of magnetite from Stages 2 and 3 indicate a typical skarn origin.

© 2016 Published by Elsevier B.V.

1. Introduction

Fluid inclusion and H–O isotope analysis has been used to trace the origin of fluids responsible for Fe–Cu skarn deposits (e.g., Kwak, 1986; Meinert et al., 2003; Peter Koderer et al., 2004; Kamvong and Zaw, 2009; Mollai et al., 2009; Xu et al., 2010; Mei et al., 2015). These studies have shown that (1) the fluid in the main skarn stage is commonly derived from magmatic water, and (2) the fluid in the sulfide stage is dominated by a mixture of magmatic water with meteoric water. Nonetheless, one of the remaining questions is

the role of fluid boiling and fluid mixing during the different stages of skarn formation and mineralization. There are different observations regarding fluid boiling and mixing in the formation of skarn and related mineralization, including (1) fluid boiling occurring in the late hydrous skarn stage (Meinert et al., 2003); (2) fluid boiling occurring in both the early anhydrous skarn and late sulfide stages (Mollai et al., 2009); (3) fluid boiling occurring in the late hydrous skarn stage and fluid mixing occurring in the late sulfide stage (Mei et al., 2015); (4) fluid mixing occurring in both the late hydrous skarn and the late sulfide stages (Xu et al., 2010); (5) fluid mixing occurring in the late hydrous skarn stage (Singoyi and Zaw, 2001; Kamvong and Zaw, 2009); and (6) both fluid boiling and

^{*} Corresponding author.

E-mail address: peini@nju.edu.cn (P. Ni).

mixing occurring in the late hydrous skarn stage (Cao et al., 2012, 2016).

The formation and trace element content of magnetite in skarns have been investigated in recent years (Shcheka et al., 1977; Shimazaki, 1998; Nadoll, 2010; Dupuis and Beaudoin, 2011; Hu et al., 2014; Nadoll et al., 2014). Some workers noticed replacement of early-stage magnetite with late-stage magnetite in Fe-Cu skarn deposits (Shcheka et al., 1977; Shimazaki, 1998; Ciobanu and Cook, 2004; Hu et al., 2014). Although this process was interpreted as a dissolution-reprecipitation process (DRP) (Putnis, 2009; Putnis and John, 2010; Hu et al., 2014), no attention has been paid to explaining the genesis of early-stage magnetite with oscillatory zoning.

The Makeng deposit is located approximately 12 km southeast of the city of Longyan, Fujian Province, and is the largest Fe deposit in eastern China (Fig. 1). It was discovered in 1957 and contains a reserve of 227 Mt of Fe at a grade of 38.5–61.6% (average 41.6%). There are two viewpoints about its genesis, including a skarn-type iron deposit (Zhao et al., 1980; Di et al., 2012; Zuo et al., 2012; Zhang et al., 2013; Zhang and Zhang, 2014; Zhang and Zuo, 2014; Zhang et al., 2015b,c; Gao et al., 2016) and a submarine volcanogenic massive sulfide iron deposit (VMS-type iron deposit) based on the geological investigation along prospecting lines 60–63 of the Makeng iron deposit (Fig. 2) (Ge et al., 1981; Wang et al., 1981; Han and Ge, 1983; Liu, 1989). Only a few geochemical studies on the origin and nature of the ore-forming fluids have been conducted (Li and Chen, 1982; Zhang et al., 2013). The

mechanism and detailed processes of magnetite precipitation have not been well understood. In this paper, we selected prospecting line 81 of the Makeng iron deposit to carry out a detailed study of the magnetite composition, fluid inclusions, and stable isotopes, to provide better constraints on the genesis and mineralization process of the Makeng iron deposit.

2. Geological setting

2.1. Regional geology

The study area is located in the southeastern part of the South China Block. The South China Block is composed of the Yangtze Block to the northwest and the Cathaysia Block to the southeast (Fig. 1). The two blocks are bounded by the Jiangshan-Shaoxing fault (Fig. 1). Southwestern Fujian Province is located in the Cathaysia Block and is divided by the Zhenghe-Dapu fault, with the Yong'an-Meizhou depression belt to the west and a magmatic arc in eastern Fujian to the east. The study area is located in the southwestern part of the Yong'an-Meizhou depression belt (Zhao et al., 1980). This belt hosts a number of Fe deposits in the Fujian Province (e.g., Longfengchang, Luoyang, and Dapai deposits) (Fig. 1). It was considered to be a Hercynian basin (Biao and Gao, 1982) underlain by a pre-Devonian basement and consisting mainly of late Paleozoic marine carbonate rocks. These sedimentary rocks are overlain by meso-Cenozoic continental clastic-volcanic rocks. There is evidence of strong Indosinian and Yanshanian igneous

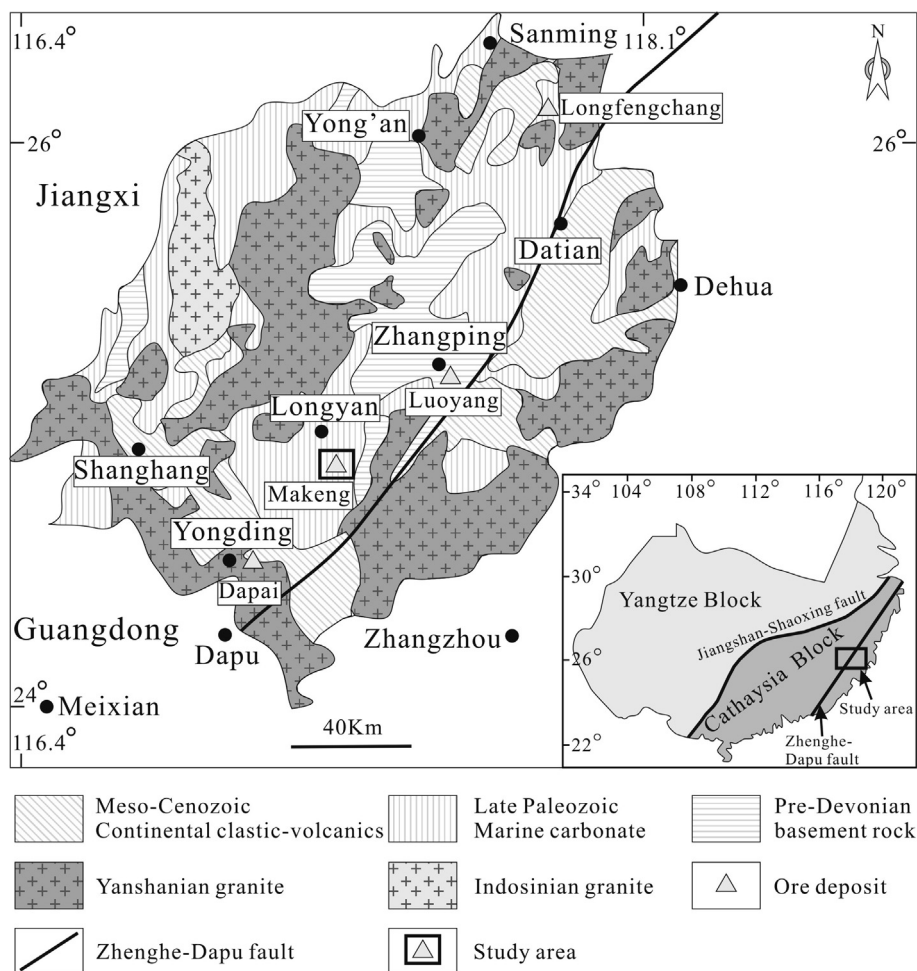


Fig. 1. Simplified map showing the location of the study area and a schematic regional geological map of the Yong'an-Meizhou depression belt in eastern China showing principal deposit localities (after Zhao et al., 1980; Zhou et al., 2006).

Download English Version:

<https://daneshyari.com/en/article/5782359>

Download Persian Version:

<https://daneshyari.com/article/5782359>

[Daneshyari.com](https://daneshyari.com)