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Genesis of Intrusive Rocks in the Chengchao Skarn Iron Deposit, Southeastern Hubei

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1 Introduction

The Chengchao iron deposit is the largest skarn iron deposit in southeastern Hubei, and contains 270 Mt Fe ores. In Chengchao mining area, the plutons are part of the southern Echeng batholith and share the similar rock types with it, including granite, quartz monzonite porphyry, diorite and minor post-ore mafic dykes. Many studies have indicated that the granite and quartz monzonite porphyry have close relationship with mineralization (Xie et al., 2012). For the intrusions, previous researches have mainly been carried out on the aspects of field geological features, petrology, chemical geology, Zircon U-Pb geochronology and Hf isotope (Xie et al., 2012; Yao et al., 2013). However, the chemical conditions of magma and magma source are poorly constrained. In this contribution, mineralogy and Sr-Nd isotopes for different types of intrusions have been studied, so as to further constraint on their petrogenesis.

2 Biotite Mineralogy and Sr-Nd Isotopes Study on the Different Types of Intrusions

2.1 The composition features of biotite

The EMP analysis was performed on the primary magmatic biotite in granite, quartz monzonite porphyry and diorite. The results show that the contents of MgO and the values of MF(Mg/(Mg+Fe^T) of biotites in granite, quartz monzonite porphyry, and diorite are between 14.4%-19.5% and 0.62-0.81; 15.5%-16.4% and 0.62-0.81;15.6%-17.9% and 0.66-0.71, respectively. According to the analyses, bioties in different intrusive rocks are dominantly characterized by high Mg and low Fe.

The biotites in granite, quartz monzonite porphyry and diorite are mainly plotted into the eastonite field, which coincide with the Middle-lower reaches of the Yangtze River area (Cheng et al., 1987). The compositional characteristics of biotites indicate that they derived from



Fig. 1 (a): $W(FeO^T)$ versus $W(FeO^T+MgO)-W(MgO)$ diagram of biotite for intrusions in Chengchao ore deposit and (b): $Fe^{3+}-Fe^{2+}$ - Mg^{2+} plot of biotite for different ore deposits in Edong district (data of biotite in rocks for Cu-W, Cu-Mo, Fe-Cu, Au-Cu deposits are from Shu et al., 1992 ;data of biotite in rocks for Cu-Fe deposit are from Zhao et al., 2010)

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mixture of mantle and crust material (Fig.1a). The average coefficient of oxidation for the primary biotite in the granite, quartz monzonite porphyry and diorite are 0.61, 0.84 and 0.69, respectively, indicating that the magma system corresponding to quartz monzonite porphyry have the highest oxygen fugacity (Fig.1b).

2.2 Sr-Nd isotopes composition

The analytical results show that the different types of intrusions at Chengchao ore deposit have initial Sr $((^{87}\text{Sr}/^{86}\text{Sr})_{I}=0.7050-0.7091)$ and ε_{Nd} [$\varepsilon_{\text{Nd}}(t)=-14.2$ ~-7.0)], respectively, and mainly distribute along the mantle evolution line that between lower crust and mantle (Fig.2). The data indicate that magma sources of the intrusive rocks are a mixture of crustal and mantle material. The decrease of $\varepsilon_{\text{Nd}}(t)$ from early diorite to late granite suggests that the early diorite have more mantle contribution than later intrusions, which is coincide with the regional magma source evolution trend (Xie et al.,2008).



Fig.2 Sr-Nd isotopes composition in Southeastern Hubei Province(except for Chengchao intrusions, data of other intrusions are from Xie et al.,2008)

3 Discussion and Conclusion

In this paper, the compositional results indicate that the magma system corresponding to the quartz monzonite porphyry has the highest oxygen fugacity, which can prohibit the metal elements precipitating in the form of sulfides and transport into the melt in the early stage (Meinert, 1995). This may provide favorable conditions for the iron mineralization. In southeastern Hubei, the

intrusions associated with iron mineralization are plotted above the Fe_2O_3 - Fe_3O_4 buffer line, and the intrusions associated with copper mineralization are plotted between the Fe_2O_3 - Fe_3O_4 and N-NO buffer line, indicating that the oxygen fugacity of magma system corresponding to the former are higher than that of later (Tan,1991).This also have close relationship with the proportion of crustal material that the skarn iron deposits is larger than that of skarn copper deposits in southeastern Hubei Province.

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