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Oxygen fugacity, temperature and pressure estimation from mineral chemistry of the granodiorite porphyry from the Jilongshan Au-Cu deposit and the Baiguoshu prospecting area in SE Hubei Province: A guide for mineral exploration

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ABSTRACT

The Jilongshan Au-Cu deposit is located in the Jiurui district of the Middle-Lower Yangtze River Metallogenic Belt in the south-eastern part of Hubei Province and close to the northern border of Jiangxi Province. This study focuses on mineral chemistry of biotite, amphibole and plagioclase in the ore-related granodiorite porphyry at the Jilongshan deposit and similar porphyry rock from the nearby Baiguoshu prospect, in an attempt to investigate the mineralization potential in the Baiguoshu area. The biotites from the Jilongshan and Baiguoshu granodiorite porphyries all belong to magnesian-biotite but the Jilongshan contains higher Mg. The calculation of Fe^{3+} and Fe^{2+} of the biotites indicated that the Jilongshan pluton shows higher oxygen fugacity that is favorable for Cu-Au mineralization, whereas the Baiguoshu pluton shows lower fO_2. The Jilongshan amphiboles show higher Mg / (Mg + Fe) and lower Si which mainly belong to magnesiohornblende, whereas the Baiguoshu accommodates mainly the tschermakite. The plagioclases of the Jilongshan and Baiguoshu plutons show no compositional difference and both belong to andesine. The calculated temperatures and pressures by the co-existing amphibole-plagioclase pairs indicate that average crystallization temperature of the Jilongshan pluton is 624–736 °C and the pressure is low at 0.5–0.9 kbar, in contrast the Baiguoshu pluton shows higher temperature of 724–832 °C and higher pressure of 3.2–6.3 kbar. These data suggest that the Baiguoshu pluton has less mineralization potential than the Jilongshan pluton, therefore the Baiguoshu prospect shows less economic importance and further exploration should be carried out at depth in the Jilongshan area.

1. Introduction

The Middle–Lower Yangtze River Metallogenic Belt (MLYRMB), which is located at the crossing points of the northern side of the Yangtze Craton, the Dabieshan orogenic belt, and the southern border of the North China Craton, is considered as one of the economically most important metallogenic belt in China (Pan and Dong, 1999). This belt accommodates > 200 Mesozoic magmatic-hydrothermal polymetallic deposits, and is composed of seven ore-concentrated districts from west to east including Edong (SE Hubei Province) Fe—Cu deposits, Jiurui (Jiujiang–Ruichang) Cu—Au—Mo deposits, Anqing–Guichi Cu deposits, Luzong (Lujiang–Zongyang) Fe—Cu deposits, Tongling Cu—Au deposits, Ningwu (Nanjing–Wuhu) Fe deposits and Ningzhen (Nanjing-Zhenjiang) Cu—Fe—Pb—Zn deposits (Fig. 1) (Zhai et al., 1996; Zhao et al., 1999). Most of these deposits and related intrusive rocks were formed within a 10 Ma period around 140 Ma (Sun et al., 2003; Ding et al., 2005; Mao et al., 2006; Jiang et al., 2008; Li and Jiang, 2009; Xie et al., 2009; Li et al., 2010; Yang et al., 2011; Jiang et al., 2013; Zhu et al., 2014). The belt has been extensively investigated during the past decades and previous work outlines that the Yanshanian (late Mesozoic) magmatism in general dominated the mineralization (Chang et al., 1991; Zhai et al., 1996; Jiang et al., 2008, 2013). Three kinds of magmatic rocks are related to different types of deposits in this belt, including: (1) high-K calc-alkaline, intermediate to felsic intrusive rocks (consisting mainly of diorite, quartz diorite, granodiorite and corresponding porphyries) related to skarn and porphyry Cu—Au—Mo

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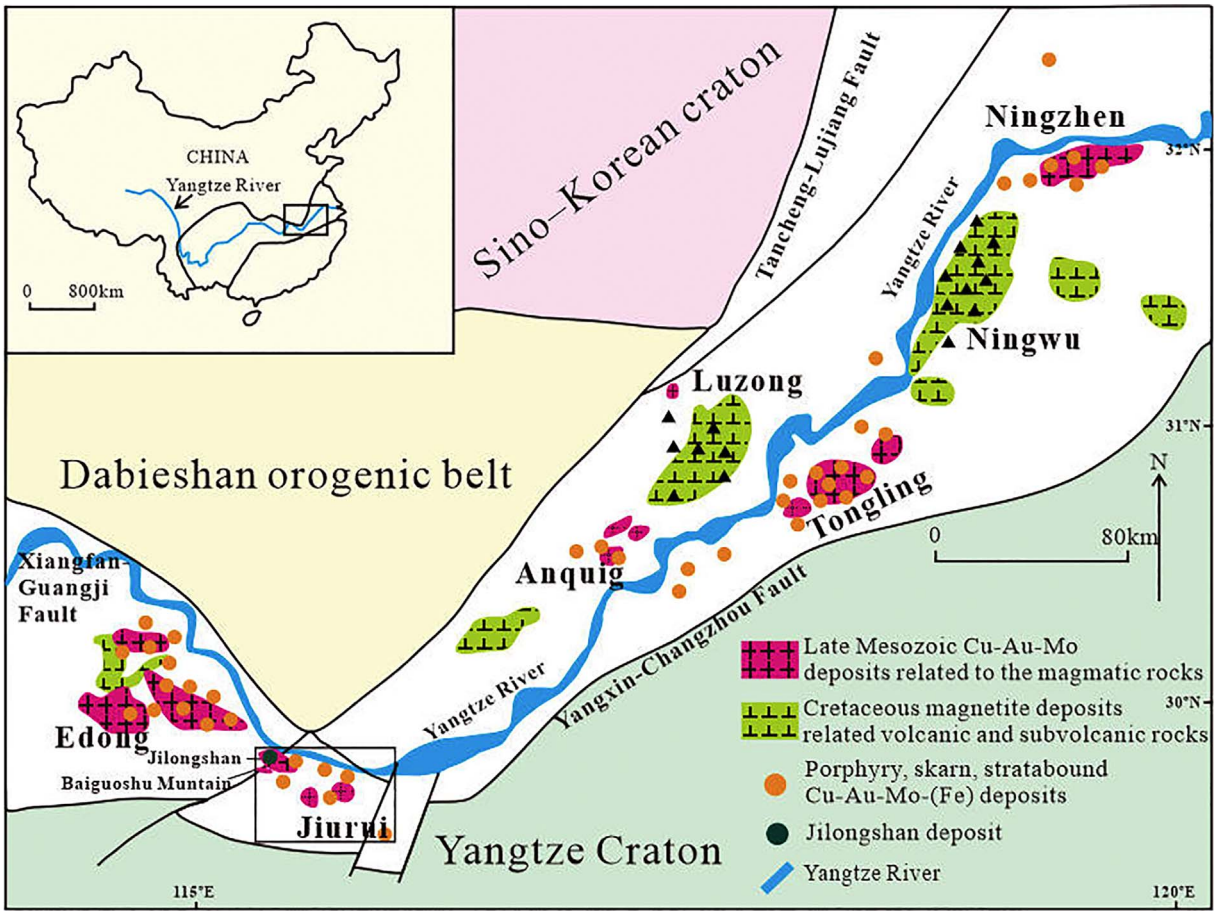

Fig. 1. Geological sketch map of the Middle–Lower Yangtze River Metallogenic Belt.

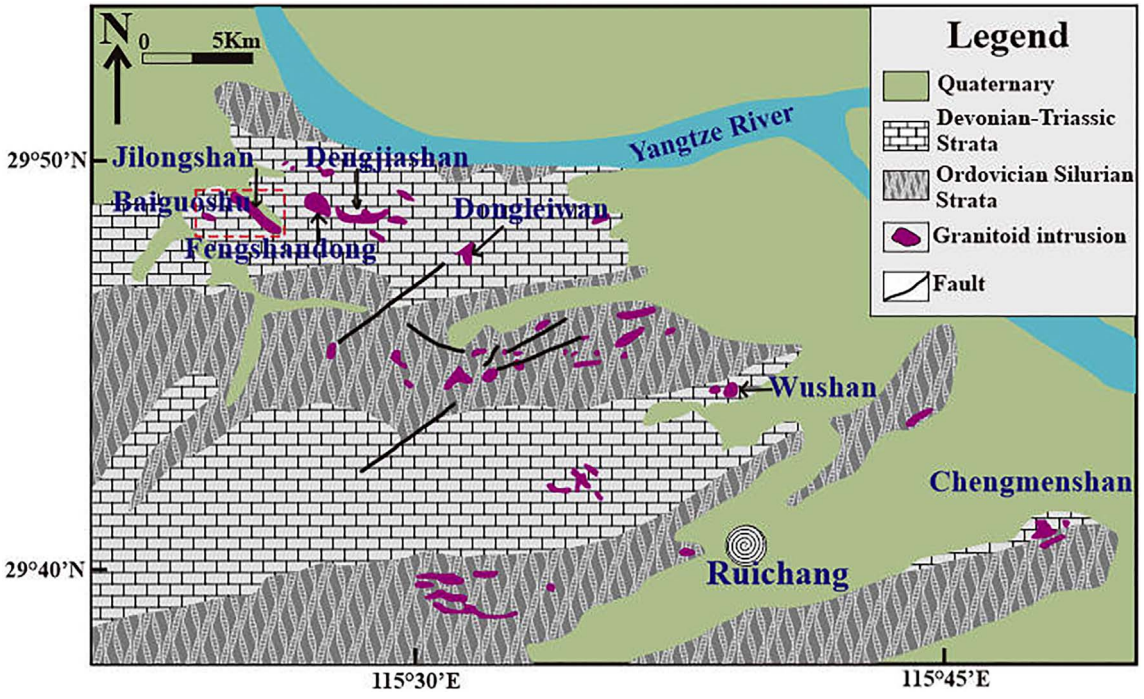

Fig. 2. Geological sketch map of the Juirui ore district.