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Geology, geochronology, and Hf isotope geochemistry of the Longtougang skarn and hydrothermal vein Cu–Zn deposit, North Wuyi area, southeastern China

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ABSTRACT

The recently discovered Longtougang skarn and hydrothermal vein Cu–Zn deposit is located in the North Wuyi area, southeastern China. The intrusions in the ore district comprise several small porphyritic biotite monzonite, porphyritic monzonite, and porphyritic granite plutons and dikes. The mineralization is zoned from a lower zone of Cu-rich veins and Cu–Zn skarns to an upper zone of banded Zn–Pb mineralization in massive epidote altered rocks. The deposit is associated with skarn, potassic, epidote, greisen, siliceous, and carbonate alteration. Molybdenite from the Cu-rich veins yielded a Re–Os isochron age of 153.6 ± 3.9 Ma, which is consistent with U–Pb zircon ages of 154.0 ± 1.3 Ma for porphyritic monzonite, 154.0 ± 0.8 Ma for porphyritic biotite monzonite, and 152.0 ± 0.8 Ma for porphyritic granite. Geological observations suggest that the Cu mineralization is genetically related to the porphyritic biotite monzonite and porphyritic monzonite. All the zircons from intrusive rocks in the ore district are characterized by $\varepsilon_{Hf}(t)$ values between −13.41 and −4.38 and Hf model ages (T_{DM2}) between 2054 and 1482 Ma, reflecting magmas derived mainly from a Proterozoic crustal source. Molybdenite grains from the deposit have Re values of 14.6–27.7 ppm, indicative of a mixed mantle–crust source. The porphyry–skarn abundant Cu and hydrothermal vein type Pb–Zn–Ag deposits in the North Wuyi area are related to the Late Jurassic porphyritic granites and Early Cretaceous volcanism, respectively. The Late Jurassic mineralization-related granites were derived from the crustal anatexis with some mantle input, which was triggered by asthenospheric upwelling induced by slab tearing during oblique subduction of the paleo-Pacific plate beneath the South China block, and the Early Cretaceous mineralization-related granitoids mainly from crust material formed within a series of NNE-trending basins during margin-parallel movement of the plate.

1. Introduction

The Qin–Hang (Qinzhou Bay to Hangzhou Bay) belt in southeastern China, located between the Yangtze and Cathaysia blocks, is a major (Cu, Mo, W, Pb, Zn, and/or Ag) polymetallic belt (Mao et al., 2010, 2011a,b,c, 2013; Yang and Mei, 1997; Zhou et al., 2012), comprising the Dexing porphyry Cu deposit (Mao et al., 2011a), Dongxiang Cu deposit (with ore type remaining unclear) (Cai et al., 2011), Yongping skarn Cu (W) deposit (Li et al., 2007), Baoshan skarn Cu–Mo–W–Pb–Zn–Ag deposit (Lu et al., 2006), Dabaoshan porphyry–skarn Cu–Mo–W deposit (Qu et al., 2014), and Yuanzhuding porphyry Cu–Mo deposit (Fig. 1a; Chu et al., 2013). The North Wuyi area, located in the northeastern part of the Qin–Hang belt (Yang and Mei, 1997), contains dozens of polymetallic Cu–Pb–Zn–Ag deposits, including the large Lengshuikeng epithermal Ag–Pb–Zn and Yongping skarn Cu (W) deposits (Fig. 1b; Hua et al., 2005; Mao et al., 2004; Wang et al., 2014; Yu et al., 2012). Although the area has been investigated by numerous previous researchers, including geologic characteristics and setting, geochronology, and petrology (Chen, 2006; Su et al., 2014; Sun et al., 2012; Yang et al., 2002; Yu et al., 2008, 2012), mineralization ages here are still unclear. Because the orebodies sometimes exhibit strata-like features, are not in direct contact with granite plutons, or lack direct dating of ore minerals, there exists debate as to whether most of these are porphyry–skarn Cu or volcanic rock-associated massive sulfide deposits (Cai et al., 2011; Dai et al., 2014; Li et al., 2007; Su et al., 2014; Wang et al., 2014; Yang and Mei, 1997; Yu et al., 2012).

The Longtougang skarn and hydrothermal vein Cu–Zn deposit is about 15 km southeast of the Yongping skarn Cu (W) deposit in Jiangxi Province (Fig. 1b). The deposit, discovered in 2009, is located in the North Wuyi area, northeastern boundary of the Cathaysia block, and close to the Jiangshan–Shaoxing suture zone, which is a deep-seated regional fault in the northern part of the Qin–Hang belt. The Longtougang

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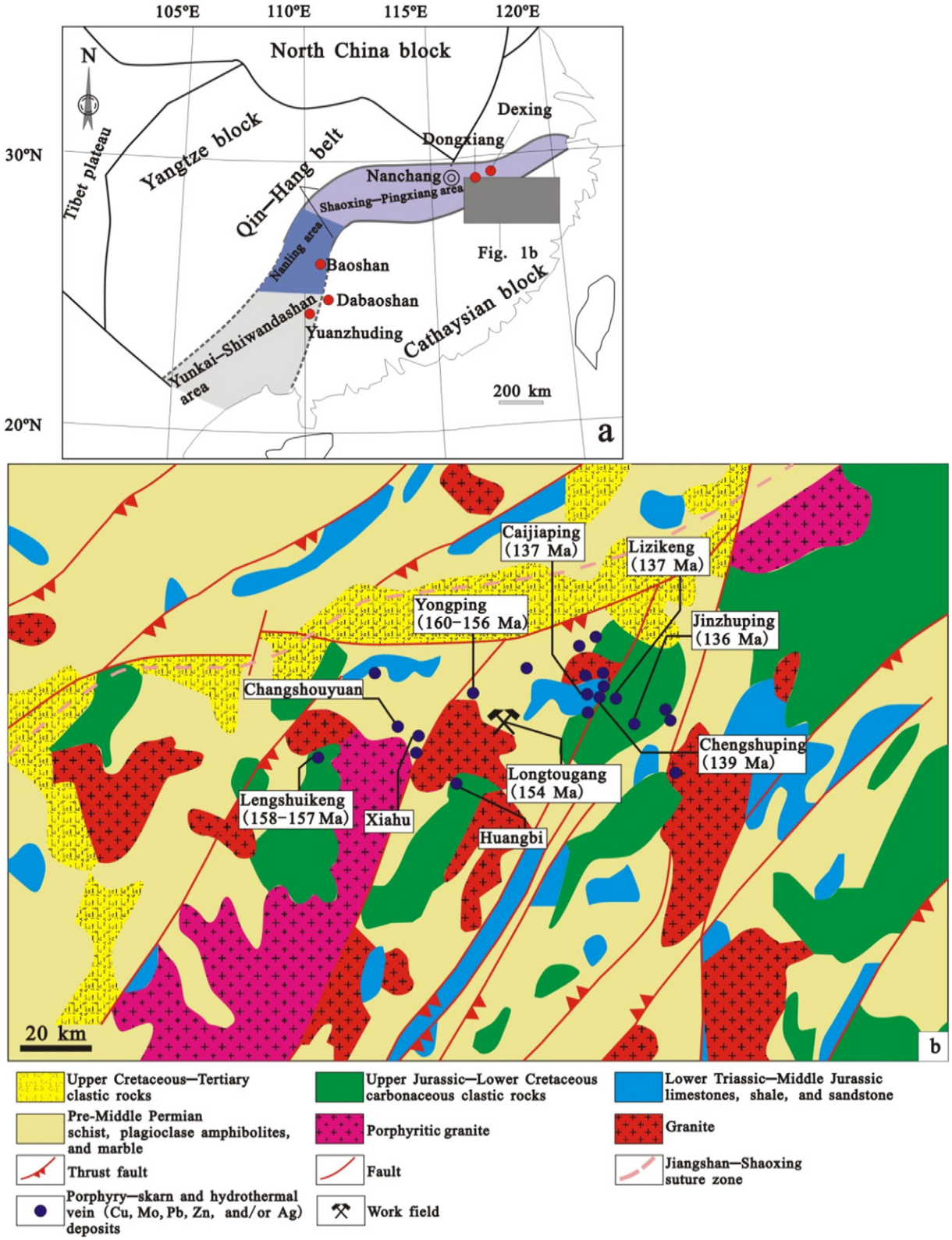

Fig. 1. (a) Schematic map of tectonic domains of southern China. (b) Simplified geological map of the North Wuyi area, showing the location of mineral deposits in the region. Modified from Yu et al. (2012).

deposit has measured reserves of ~68,000 tonnes (t) of Cu with an average grade of 1.5% and ~59,000 t of Zn with an average grade of 2.0%. By-products of the future mining operations include Ag, Pb, Mo, and Fe. Exploration is currently on going and proposed annual production is expected to be 2000 t of Cu and 1700 t of Zn beginning in 2014 from underground. The further exploration is still going on.

This paper first describes the Longtougang deposit geology, and includes high precise laser ablation–multicollector–inductively coupled