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Metallogenic Epoch and Tectonic Setting of Bangongco Porphyry Copper Belt, North Tibet

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Bangongco porphyry copper belt is a newly discovered belt recent years and have a tremendous potential after Yulong and Gangdese Porphyry copper belt in Tibet.It locate in the northern Bangongco belt and southern Qiangtang terrane, and is mainly composed of Qingcaoshan porphyry Cu-Au deposit, Duobuza porphyry Cu deposit and Bolong porphyry Cu deposit.There are two entirely different viewpoint about the formation processes of Bangongco porphyry copper belt.One point is that the formation of it relateded to the northward subduction of Bangongco oceanic crust(Li et al., 2007; Li et al.,2008; She et al.,2009). Nevertheless, another point is that the mineralization occurred at crustal uplift stage after collision(Qu et al.,2006; Xin et al.,2009).

Based on the zircon U-Pb geochronology and trace element geochemistry of the ore-bearing porphyry in Qingcaoshan, combined with other deposits in the belt at the same time, we discuss the metallogenic epoch, tectonic settings and geodynamic mechanism of Bangongco porphyry copper belt in this article.

1 Geologic Setting

Bangongco suture is located in the south central Tibet Plateau, and between Lhasa terrane and Qiangtang terrane (Fig 1). Because of the wide transverse distribution, complex combination of ophiolite and the uneven distribution of igneous rocks, the key geological problems in the evolutionary process of Bangongco belt is controversial still at present (such as the opening and closing time of Bangongco ocean, subduction polarity of oceanic crust, et al).

For the forming time of Bangongco ocean, Qiu et al. (2004) get the Sm-Nd internal isochron age of (191±22) Ma through the research of layered gabbro in Shemalagou ophiolite western Bangongco belt.This situation implies that the forming time of Bangongco ocean is earlier than early Jurassic. The zircon U-Pb age of 116.19±0.65Ma of SSZ-type ophiolites in the westernmost Bangongco belt, indicates that Bangongco ocean turn from spreading to subduction at Middle Jurassic at least(Shi, 2007).

The research of a large number of igneous rocks in central and northern Lhasa terrane, indicates that Bangongco ocean subducted southward and occurred slab break-off, which induced the large scale magmatism at 113Ma early Cretaceous(Zhu et al., 2011). However, the existence of 111.1±1.4Ma island arc volcanic in northern belt reflects that Bangongco ocean also subduct northward at early Cretaceous(Li et al., 2011).

For the closing time of Bangongco ocean, the research of strata's deformation and geochronology in the Shiquanhe area of far-western Tibet indicates that the closing time of Bangongco ocean is between late Jurassic and early Cretaceous(Kapp et al., 2003). Nevertheless, nearly hundred square kilometers ocean island at early Cretaceous is found in Tarenben downstream Zhajazangbu. The zircon SHRIMP U-Pb age of allivalite

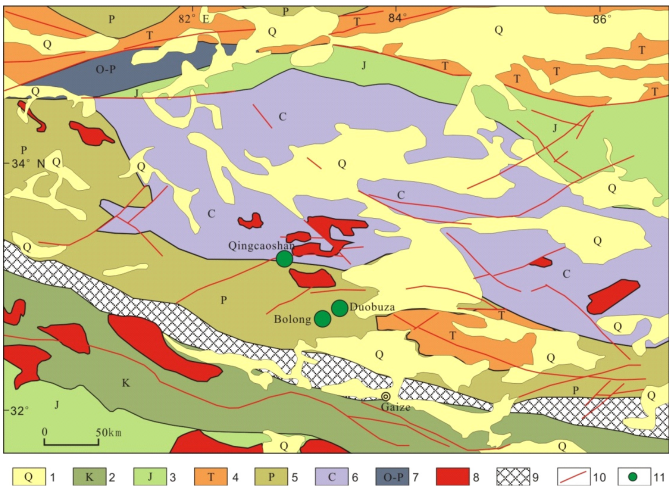

Fig 1 Geology sketch map of Bangongco porphyry copper belt (modified from 1:1500000 geologic map of Tibet Plateau)
1—Quaternary; 2—Cretaceous; 3—Jurassic; 4—Triassic; 5—Permian; 6—Carboniferous; 7—Ordovician-Permian; 8—igneous rocks; 9—melange; 10—fault; 11—porphyry copper deopists

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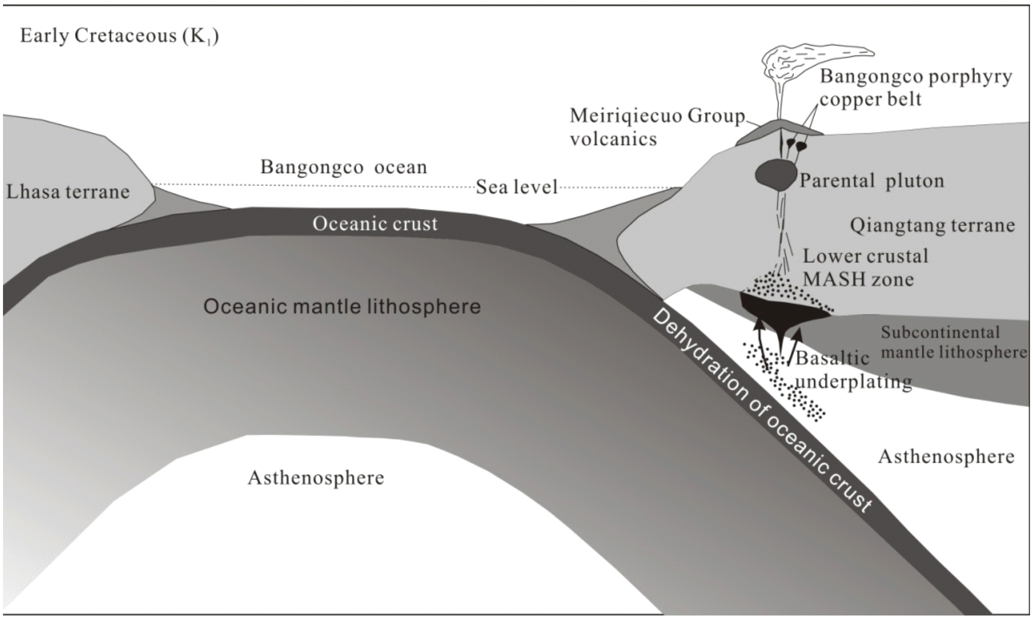

Fig 2 The continental dynamics process of the formation of Bangongco porphyry copper belt(modified from Richards,2003)

cumulates in Dongcuo ophiolites western Bangongco belt dated to be 116.19±0.65Ma. About 110Ma oceanic island basalt widely distributed in the Renben area of southern Shuanghu(Zhu et al., 2006a; Zhu et al., 2006b).Above all, the closing time of Bangongco ocean should later than early Cretaceous.

2 Deposit Distribution

In Bangongco porphyry copper belt, there are some large-scale porphyry copper deposits so far, such as Qingcaoshan porphyry Cu-Au deposit, Duobuza porphyry Cu deposit and Bolong porphyry Cu deposit (Fig 1).

The stratum exposed in Qingcaoshan porphyry Cu-Au deposit is Jurassic Quemocuo Formation, and main lithology is daffodil yellow medium thickness metasandstone, greyish-green thin metamorphic siltstone. The periphery of deposit also exposed of Cretaceous Meiriqiecuo Formation volcanics, and the lithology is mainly andesite, dacite and pyroclastic rock. Ore bearing granodiorite-porphyry, which like an irregular ellipse, emplace in Quemocuo Formation. Zircon U–Pb dating of ore bearing porphyry gives an emplacement age of 116.19±0.65Ma. Broad and intense hydrothermal alteration, which has a typical alteration-mineralization zoning pattern of porphyry copper deposits, is apparent in the deposit. The principal ore minerals mainly comprises malachite and chalcopyrite. The main texture of ores is xenomorphic-granular texture, and the main structure is disseminated and veinlet-disseminated structure.

In Duobuza porphyry Cu deposit, the stratum exposed is middle Jurassic Yanshiping Group and Lower Cretaceous Meiriqiecuo Group. The main lithology is sandy slate and feldspathic quartz sandstone. Granodiorite-porphyry, which emplaced as a stock and have intense hydrothermal alteration, is ore-bearing rocks. The zircon U–Pb dating of ore bearing porphyry gives an emplacement age of 120.9 ±2.4Ma(She et al., 2009). The principal ore minerals mainly comprises chalcopyrite, pyrite, magnetite, bornite and molybdenite, and the main structure is veinlet-disseminated structure.

Bolong porphyry Cu deposit, located in Gaize County Tibet, is adjacent to the Duobuza porphyry copper deposit. The stratum exposed in Bolong deposit is Jurassic Quse Formation and Lower Cretaceous Meiriqiecuo Formation. Jurassic Quse Formation, which is the surrounding rock of Bolong deposit, the main lithology of it is feldspathic quartz sandstone. Granodiorite-porphyry also is ore-bearing rocks. The Re-Os dating of molybdenite gives a metallogenic age of 119.4±1.3Ma (Zhu et al., 2011).

3 Metallogenic Epoch and Tectonic Setting

The zircon (Yb/Dy)N vs Y, (Lu/Hf)N vs Y, Th vs Y and Ce vs Y abundance diagram indicates that Qingcaoshan ore-bearing porphyry generated in island arc and active continental margin settings. In the zircon U/Yb vs Hf and U/Yb vs Y abundance diagram, the zircon of Qingcaoshan porphyry all plotted in continent settings. Above all, Qingcaoshan porphyry Cu-Au deposit formed in continental settings and was closely related to magma arc. In other words, Qingcaoshan porphyry Cu-Au deposit formed in continental arc. In igneous rock association, ore-bearing granodiorite-porphyry associated with comagmatic Cretaceous Meiriqiecuo Formation volcanics (mainly composed of andesite and dacite), is consistent with the igneous rock association of continental arc. This confirms that Qingcaoshan porphyry Cu-Au deposit formed in continental arc.

The zircon U–Pb dating of Qingcaoshan ore bearing porphyry gives an emplacement age of 116.19±0.65Ma. In Duobuza porphyry Cu deposit, which also located in the northern Bangongco belt and southern Qiangtang terrane, the zircon SHRIMP U–Pb age of 120.9±2.4 Ma is the forming age of porphyry (She et al., 2009), and it is close to Qingcaoshan deposit. At the same time, the geochemical diagram of Duobuza porphyry indicates that Duobuza deposit formed in continental arc(Qu et al., 2006; Xin et al., 2009; She et al.,2009). This situation is consistent with Qingcaoshan deposit. Summing up the above, the metallogenic epoch and tectonic settings of Qingcaoshan and Duobuza porphyry deposit is consistent. Combined with Bolong porphyry Cu deposit (Zhu et al., 2011), which metallogenic age (119.4±1.3Ma) is also consistent with Qingcaoshan and Duobuza deposit, there deposits constitute the Bangongco porphyry copper belt.

The metallogeny of Bangongco porphyry copper belt is controversial so far.One point is that it formed in island arc setting (Li et al., 2007; Li et al.,2008; She et al.,2009). Nevertheless, another point is that the mineralization occurred at crustal uplift stage after collision(Qu et al.,2006; Xin et al.,2009). In the process of discussion in this paper, we put forward that Bangongco porphyry copper belt form in neither island arc setting nor collision setting, but is continental arc setting.

Based on the classical metallogenic model of porphyry copper deposits in arc settings(Richards. 2003；Sillitoe. 2010), we put forward the geodynamic mechanism of Bangongco porphyry copper belt. In the early Cretaceous, Bangongco oceanic crust was subducting northward. In a proper depth, mass dehydration effect occurred in oceanic plate and it caused partial melting of mantle wedge. The magma enriched in metallogenic components,which migrated upward and developed into a magma chamber. Some of them erupted and formed Meiriqiecuo Group volcanics. Particular part of them emplaced in hypabyssal-ultra shallow crust and formed porphyritic plutons or porphyry deposits.With the magma emplaced in the different age and place, finally formed the Bangongco porphyry copper belt(Fig 2).

4 Conclusions

Bangongco porphyry copper belt formed at early Cretaceous and continental arc setting.