Porphyry deposit system generates three fourth of the world’s copper (Cu) and one fifteenth of the world’s gold (Au) (Sillitoe, 2010), with 97% of the giant-large porphyry Cu (Mo-Au) deposits being generated in magmatic arc setting (Richards; 2003; Cooke et al., 2005; Sillitoe, 2010). Nevertheless, recent studies indicate that important porphyry deposits may also be formed in subduction-unrelated environments, e.g., along continental collision-related orogeny and intracratonic setting (Hou et al., 2009; Chen, 2013; Zhou et al., 2011).

The Middle-Lower Yangtze Metallogenic Belt (MLYB) is one of the most important Cu-Au-polymetallic metallogenic belts in eastern China, and has been studied extensively in the past (Zhou et al., 2008). Various models have been proposed concerning the regional metallogeny, with major ones including the “porphyrite iron deposit” (NW Group, 1978), “stratabound skarn deposits” (Chang et al., 1991) and the “superimposed metallogenic system” (Zhai et al., 1992; Chang et al., 2012). With the discoveries of large porphyry Cu-Au deposits at Shaxi and Shujiadian in the recent years addition to the previous discovered porphyry deposits such as Chengmenshan and Fengshandong and other deposits, porphyry deposits are becoming more important exploration targets in the MLYB. Their nature and origin are still controversial, and are attributed variably to be the products of intracratonic magmatism (Hou et al., 2009; Chen, 2013; Zhou et al., 2011) or of the subduction of the Paleo-Pacific Plate (Ling et al., 2009, 2011; Liu et al., 2010; Sun et al., 2010; Xie et al., 2012), and recent study are more and more tend to the former point (Chen et al., 2014; Lv et al., 2014; Wang et al., 2014).

To further illustrate the differences between the porphyry deposits formed in intracratonic setting and magmatic (continental or island) arc setting, we have chosen typical continental margin arc porphyry deposits, i.e., Bingham Canyon (US) and Bajo de la Alumbrera (Central Andes); island arc porphyry deposits, i.e., Panguna (PNG) and Batu Hijau (Indonesia) to compare with the MLYB porphyry deposits. It is summarized that:

1. Distribution of magmatic (continental or island) arc-generated porphyry deposits is commonly linear, and is parallel to the orogeny and perpendicular to the subduction zone (Sillitoe, 2010). The MLYB porphyry deposits are distributed along the Yangtze Fault, oblique to the Paleo-Pacific subduction zone.

2. Magmatic arc-generated porphyry metallogenic systems are commonly preceded by calc-alkaline or alkaline felsic volcanism (Sillitoe, 1973) that occurs ca. 0.5 – 3 Ma prior to the porphyry emplacement, as evidenced at Bingham (Waite et al., 1997), Farallón Negro (Argentina; Sasso and Clark, 1998; Halter et al., 2004), Yerington (Dilles and Wright, 1988; Dilles and Proffett, 1995), Tampakan, Philippines (Rohrlach and Loucks, 2005) and Yanacocha (Longo and Teal, 2005). No coeval (or similar age) volcanism with the porphyry deposits has been documented in the MLYB.

3. Types of wall rocks vary in different deposits, suggesting porphyry Cu deposits are indiscriminative towards their wall rocks. Wall rocks for magmatic arc-generated porphyry deposits are commonly volcaniclastic rocks, whereas wall rocks for the intracratonic MLYB porphyry deposits contain sandstone (e.g., Shaxi) and carbonates (e.g., Tongshankou).

4. Major metal sulfides in the MLYB include chalcopyrite, pyrrhotite, pyrite, and bornite. Pyrrhotite is closely associated with skarn, and may suggest the reducing nature of the wall rocks (Kosaka and Wakita, 1978; Perelló et al., 2003), in accordance with the formation of magmatic arc-generated porphyry deposits (Sillitoe, 2010). The MLYB porphyry deposits contain the same vein types as typical magmatic arc-generated porphyry deposits, but with different vein type proportion:
In arc-generated porphyry deposits, veins of the potassic alteration stage have contributed most of the metals for the deposits; whereas in the MLYB porphyry deposits, veins of the potassic-phylllic alteration transition stage have contributed most of the metals for the deposits (Yuan et al., 2012).

5. The MLYB porphyry deposits contain basically the same alteration types and similar zonations as in typical magmatic arc-generated porphyry deposits. Nevertheless, advanced argillic lithocaps and shallow intermediate-high sulfidation alteration do not commonly appear in the MLYB porphyry deposits, which may have been a result of prolonged erosion. Compared with typical magmatic arc-generated porphyry deposits, alteration in the sedimentary strata at the Shaxi- and Shuiadian deposits is less developed, and the ores in these two deposits occur mainly as veins. This may have been caused by the sandstone wall rocks, which are more stable and are thus less likely to be altered. In contrast, wall rocks of typical magmatic arc-generated porphyry deposits (commonly volcanoclastic rocks) are more prone to alteration.

6. In general, magmatic rocks associated with porphyry ore formation are of calc-alkaline series. Ore-bearing porphyries in typical continental arc setting are mainly calc-alkaline and minor high-K calc-alkaline, with rock types include granodiorites and quartz monzonites (Singer et al., 2005); Ore-bearing porphyries in typical island arc setting are typically calc-alkaline, with rock types include granodiorites, quartz monzonites and syenites (Misra, 2000). Compared with these arc-related porphyries, the MLYB ore-bearing porphyries are mainly calc-alkaline to high-K calc-alkaline.

7. Typical magmatic arc-generated ore-bearing porphyries are generally considered to be formed by partial melting of metasomatized mantle wedge (Richards et al., 1995). As discussed earlier, the MLYB ore-bearing porphyries are better ascribed to be formed by magma mixing between an enriched mantle-derived magmatic magma and a magma generated by partial melting of the thickened lower crust.

8. Ore-forming materials for typical magmatic arc-generated porphyry deposits are mainly originated from oceanic plates, when dehydration carries substantial amount of H2O, S, Cl and metals to the overlying mantle wedge (Tatsumi et al., 1996). The MLYB ore-bearing porphyries are most likely to be originated from enriched mantle-derived mafic magmas. The ore-forming fluid of the porphyry deposits in the MLYB were magma-derived, and there was late stage meteoric water involvement, similar to typical magmatic arc-generated porphyry deposits (Sillitoe, 2010).

To summarize, the MLYB porphyry deposits contain fundamentally the same geological characteristics as typical magmatic arc-generated porphyry deposits, but their major mineralization vein types are different, and argillic alteration does not occur. The nature of magma source and origin of ore-forming materials are the major differences between the MLYB porphyry deposits and those of typical magmatic arc-generated porphyry deposits.

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