The Geological Characteristics and Genesis of Beiya Gold-polymetallic Deposit, Yunnan Province, China

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Beiya large gold polymetallic deposit is located in the Beiya township of Yunnan Heqing. It is a typical deposit that relates with the Himalayan alkali-rich porphyry in Southwest Sanjiang region in China. Since 1982, there have been a number of units and scholars have done the geology and Mineral Exploration and the research work in the mining (Cai, 1991; Ge et al., 2002; Yang et al., 2002; Xu et al., 2006; Xue et al., 2008; Xiao, 2009; Deng et al., 2010; He et al., 2012; Zou et al., 2013). The mines gold reserves has more than 200 tons and reaching large scale. Which were associated lead, zinc, silver, copper, iron, sulfur that were also reaches large-medium-scale. It shows a gold polymetallic mineralization Concentrated area in the area of the southwestern margin of the Yangtze platform. Because of the lower level of work in the area of geological research, geological characteristics of the deposit, ore field structure, ore-controlling factors of research is relatively weak, limiting the further prospecting and exploration work. On the research of geological mapping and mine ore-controlling factors, the mineralization process, discusses the geological characteristics of the deposit and the genesis. We have Proposed the mine prospecting direction.

1 Geological Setting

Beiya gold polymetallic deposit is located in the site of the Yidun island arc and the Yangtze Block and the Jinsha River and—Red River Plate suture zone (BGMRY, 1990). Between the Jinsha—Red river Plate suture zone with the Binhuan - Chenghai fracture and Lijiang—Muli fracture. In the mining area and perimeter mainly exposed to the Triassic strata, followed by the Upper Permian Emeishan Basalt and Eocene and Quaternary Pleistocene deposits. Among them, the Triassic strata mainly for delta—shore shallow carbonate platform - shallow muddy sand Slope turbidite facies—shore shallow carbonate platform—shore shallow shelf - delta facies. From top to bottom into the Qingtianbao Formation (T\(_{1q}\)) clastic rocks, Beiya Formation (T\(_{2b}\)) carbonate rocks interbedded fine clastic — carbonate rocks, Zhongwo Formation (T\(_{2z}\)) limestone, Songgui Formation (T\(_{3sg}\)) clastic rocks. Gold deposits have been found mainly in contact zone of the Beiya Formation carbonate rocks with the Himalayan

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alkali-rich porphyry.

The regional development of basic, neutral, acidic and alkaline magmatic rocks that can be divided into three periods of magmatic activity. One is mafic gabbro, basalt Permian magmatic activity based on the Variscan epoch; Second is mainly quartz porphyry alkali—rich pyroxene syenite, granite and quartz diorite porphyry, syenite porphyry and lamprophyre magmatism in the Yanshan epoch—the early Himalayan epoch; Third is mainly acidic and alkali-rich porphyry intrusion picrite basalt, olivine basalt, alkaline rocks effusive in the Himalayan epoch. Beiya mine and its peripheral base rock and gold-rich poly-metallic deposits (points) is located within the group of the alkali-rich porphyry in the Yanshan epoch—the Himalayan epoch. The deposit type have porphyry, skarn, hydrothermal filling type, blasting breccia type, superimposed hydrothermal transformation of gold poly-metallic deposits and lateritic gold deposits.

2 Geological Characteristics of the Deposit

2.1 Mine strata

The mine strata have the Upper Permian Emeishan group (Pe) basalt, the lower Triassic Qingtianbao Formation (Tbq) clastic rocks, the middle Triassic Beiya Formation (Tb) carbonate rocks interbedded fine clastic—carbonate rocks and Quaternary (Q) sediments. But in the Middle Triassic Beiya Formation (Tb) Outcropping based, thickness of 1080m. The Upper Permian Emeishan basalts are mainly located in the eastern part of the mine. The lower Triassic Qingtianbao Formation is mainly distributed in the north west and the east, thickness of 407～448m. The Pleistocene and Holocene of the Quaternary (Q) sediments is mainly composed of complex components gravelly sand, Clay, sand and eluvial gravel, rock and other components. Thickness 0～175m. It is the main formation of the lateritic gold ore in mine.

2.2 Mine construction

The mine folds is mainly SN-trending of Beiya-Songgui syncline. There are three main faults groups in mining: The SN—trending faults are rock control and ore—controlling faults of alkali-rich quartz porphyry and skarn gold poly-metallic mineralization in the early Himalayan epoch; The NE-trending faults are the alkali-rich porphyry and hydrothermal filling control rock type and explosive breccia type gold-poly-metallic mineralization of ore-controlling faults in the mid—Himalayan; The EW trending faults are the alkali—rich porphyry ore veins control over rocks and porphyry, skarn, hydrothermal filling type, superimposed hydrothermal transformation of type gold poly-metallic deposit in the late Himalayan epoch and weathered an accumulation of gold poly-metallic lateritic ore and gold mineralization in the ore-controlling fracture.

2.3 Magmatic

The mine have basic, neutral, acidic and alkaline igneous rocks. The Variscan of the Permian Emeishan basalt is mainly exposed in the eastern part of mine. The early Himalayan mainly quartz albite porphyry, lamprophyre, the mid Himalayan is mainly quartz syenite porphyry, syenite porphyry, hydrothermal breccia, etc., the late Himalayan of Gold mineralization is pyrite syenite porphyry and biotite lamprophyre. Beiya quartz syenite porphyry mines zircon LA—ICP—MSU U—Pb dating age of 36.36 ± 0.26Ma (He et al., 2013); Beiya feldspar syenite porphyry K—Ar age of 27.30Ma (Zhang, 1997). Among them, the mid Himalayan of quartz syenite porphyry and skarn, hydrothermal filling gold poly-metallic mineralization is most closely. The late Himalayan of pyrite gold mineralization biotite syenite porphyry and porphyry, epithermal filling gold-poly-metallic mineralization the role is most closely.

2.4 Orebody characteristics

Containing mineralization and ore is control by SN—trending to nearly EW and NE—trending faults and the Himalayan epoch porphyry. The main mine is located in the middle of ore zone in Wadongshan mine. Ore genesis can be divided into five types: produced in the contact zone of quartz syenite porphyry of skarn bodies in the mid-Himalayan; produced in pyrite and gold mineralization of biotite feldspar porphyry and its cracks and joints of the porphyry ore in the late Himalayan; produced in the surrounding rock in the fault fracture zone in Layered, vein and stockwork hydrothermal type ore; produced in the Quaternary sediments eluvial gold poly-metallic ore; production in lateritic weathering crust and karst cave gold poly-metallic ore.

It has been delineated over 400 gold, iron, copper, silver, lead and zinc poly-metallic ore body, the larger orebodies have 12 in the Mine. The largest orebody of KT52 length 1360m, deepening 540m, thickness 0.86～103.76m. The average grade is Au2.68g / t, FeT /% of 35.69, mFe /% of 24.42, Cu of 0.42%, Ag of 42g / t, Pb of 1.29%, Zn of 0.33%(He et al., 2013). The orebody is large scale.

2.5 Ore types and features

Skarn-type ore is mainly in blocks, veins, disseminated structure, Metal ore minerals are magnetite, pyrite, galena, sphalerite, chalcopryite, bornite, malachite, native gold,
native silver and silver gold and other gangue minerals are mainly pomegranate, pyroxene, feldspar, quartz, calcite, chlorite, epidote, dolomite, barite, celestite and chrome mica water.

Porphyry type ore is mainly disseminated or vein-like structure. Metal ore minerals are chalcopyrite, bornite, pyrite, malachite, native gold and electrum, etc.; Gangue minerals are K-feldspar, plagioclase, quartz, biotite, epidote, chlorite.

Hydrothermal ore is mainly stratiform, vein and stockwork structure. Metal ore minerals are magnetite, chalcopyrite, pyrite, galena. Natural gold; Gangue minerals are quartz, calcite, dolomite, Epidote, chlorite.

The metal mineral ore and gangue minerals of eluvial type metal mineral ore is basically the same with the hydrothermal ore.

The structure of lateritic gold polymetallic ores are mainly hull shape, bell emulsion, porous, grid, etc. Ore minerals are mainly: limonite, magnetite, native gold, etc.; gangue minerals are mainly clay and grit stone.

Ore structure is mainly subhedral - euhedral, dissolution account, account remnants, fragmentation structure, the solid solution Separating structure and the false structure comprising structure.

2.6 Mineralization period and stages

According mineralization characteristics, ore texture and structure, mineral assemblages, mineral formation typomorphic characteristics and temperature data and comprehensive study showed that the metallogenic process of Beiya have been through the skarnization period, hydrothermal mineralization and supergene mineralization three stage mineralization.

2.7 Rock alteration

Beiya mine rock alteration types are mainly skarn, in addition to chlorite, epidote, carbonate, silicification, potassic alteration, etc.

3 Deposit Geochemical Characteristics

Beiya Alkali-rich porphyry of the $^{87}$Sr/$^{86}$Sr initial value is 0.706 ~ 0.709, divided into light rare earth REE enrichment, Eu anomaly is not obvious (Xu et al, 2006), indicating magma mainly from the upper mantle, and some alumina crust source material mixed with them (Deng et al, 1998; Hou et al, 2007).

Deposit geochemical studies indicate that the primary ore pyrite, chalcopyrite and galena of the sulfur isotopic $\delta^{34}$S values of -6.6 %o ~ 4.5 %o, with an average of +2.17 %o, and the $\delta^{34}$S values of porphyry alteration zone (0.1 %o ~ 3.7 %o) (Liu et al, 1991) are similar, but also with the meteorite sulfur (0 %o) are similar.

The $^{206}$Pb/$^{204}$Pb, $^{207}$Pb/$^{204}$Pb, $^{208}$Pb/$^{204}$Pb ratios of ore were 17.969 ~ 18.642, 15.226 ~ 15.837, 37.591 ~ 39.543, and the Pb isotopic ratios of alkali-rich porphyry are similar (Ge et al, 2002; Liu et al, 2003, 2004; Xiao et al, 2011, He, 2012). Early mine gangue minerals calcite $\delta^{13}$C and $\delta^{18}$O were -5.05 %o and 11.57 %o, and carbon isotopes and magma mantle oxygen isotopic composition of water rather (Xiao et al, 2009). The early calcite $\delta^{13}$C and $\delta^{18}$O of the gangue minerals were -5.05 %o and 11.57 %o, and carbon isotopes is similar to the oxygen isotopic composition of magma mantle water in Beiya mine (Xiao et al, 2009).

The research have shown that ore-forming materials have been both the composition of the mantle and magma source area of the component.

3.1 Mineralization age

The early quartz albite porphyry and lamprophyre emplacement in the 60-65Ma. The midquartz syenite porphyry and lamprophyre emplacement in the 36-33Ma. The late biotite quartz syenite porphyry in 3.7Ma emplacement. The skarn genesis of muscovite crystallization age is 32.5Ma in Beiya mining (He et al., 2012, Zou et al., 2013), It can represent the mineralization age. Mineralization is closely related to the mid quartz syenite porphyry and -and the late biotite quartz syenite porphyry.

3.2 Genesis of deposit

In summary, the Beiya deposit is belong to alkali-rich porphyry of high temperature hydrothermal filling skarn and iron,copper,gold polymetallic porphyry deposit in the mid to late Himalayan.

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References


